



# **Detection of COVID-19 and Cardiovascular Diseases By ECG**

# Our team



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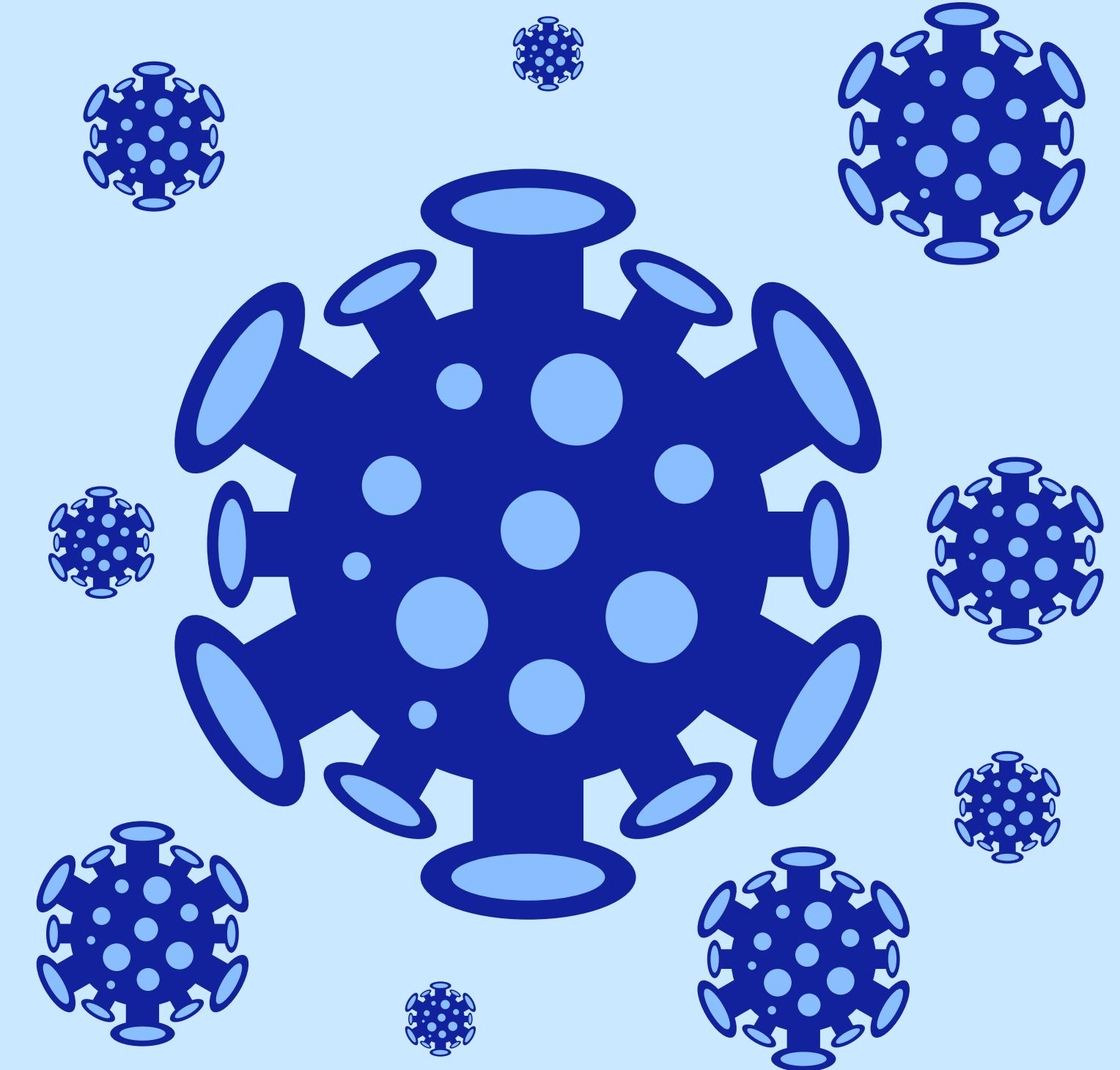
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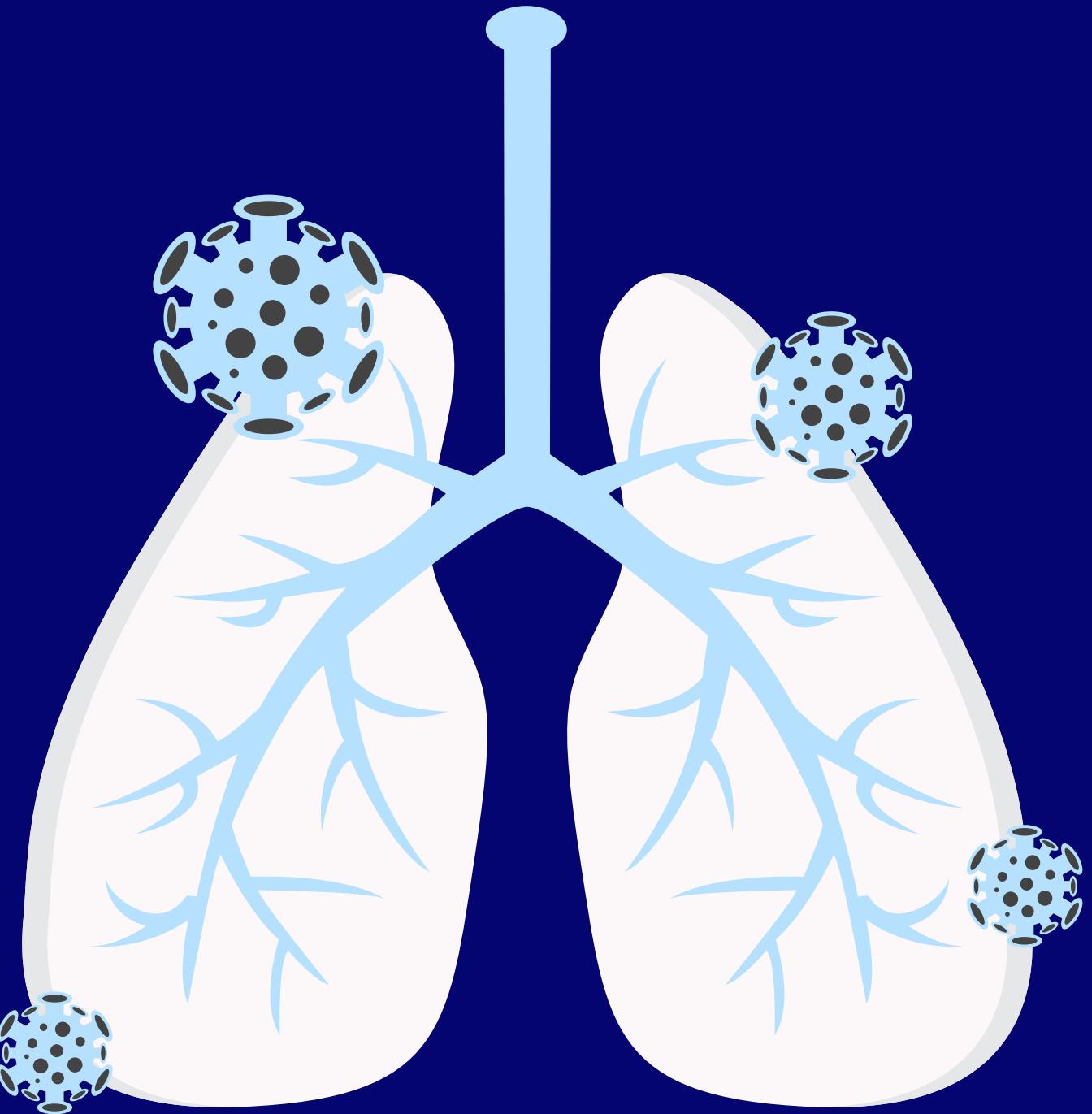
# **OUTLINE**

- Introduction
- Motivation
- Problem statement
- Problem solutions
- Related work
- Data Set
- implementation
- Model Structure
- Methodology
- Technologies
- Time plan



01

# INTRODUCTION



★It was discovered recently that COVID\_19 affects several organs in the human body, especially the cardiovascular system.

December 2019

March 2020

February 2023

753 million

6.8 million

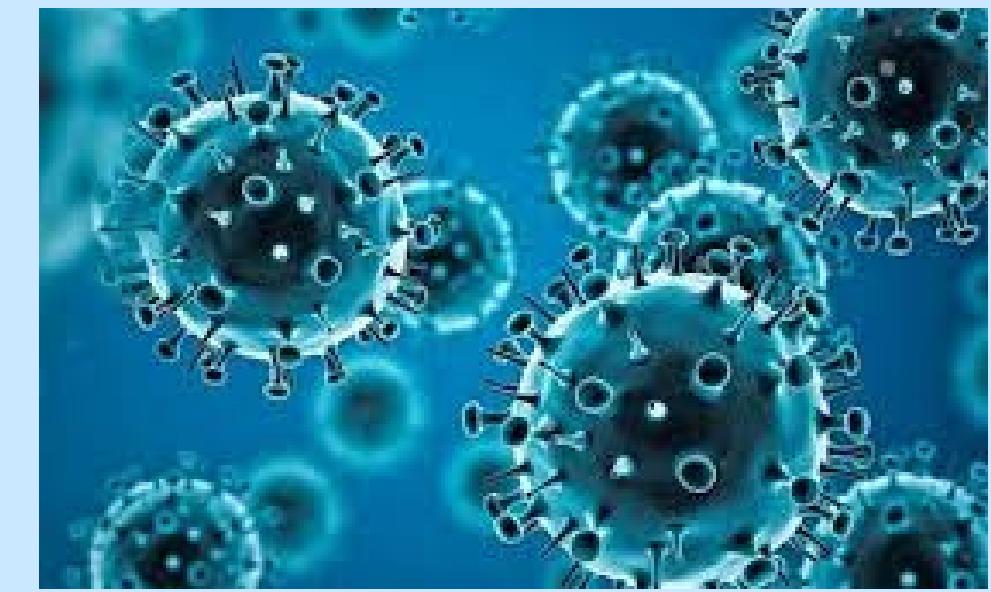
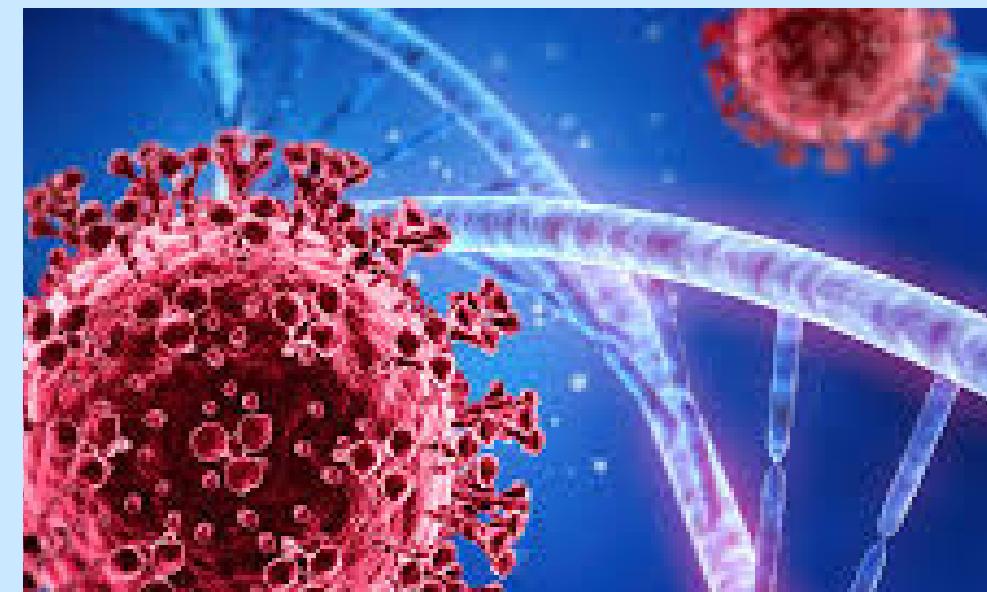
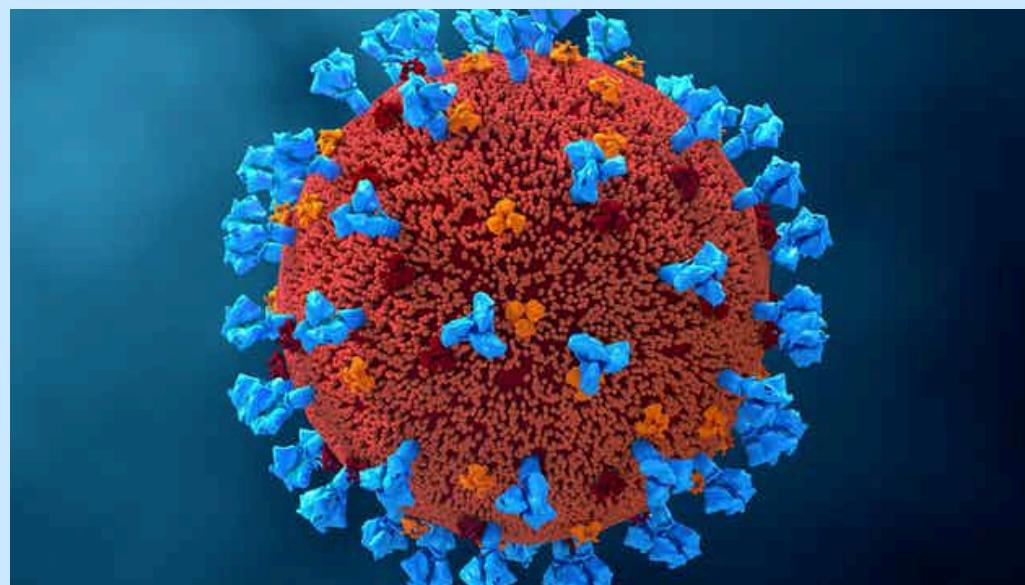
The covid19 first appeared in China

It was noted that the number of deaths worldwide due to this virus was significant

according to a report presented by the World Health Organization

people were infected with this disease

deaths



★ It was estimated by the World Health Organization (WHO) in February 2023 that more than 17.9 million people are dying due to CVD

## SOME OF THE DISEASES THAT CAN AFFECT THE HEART INCLUDE:

- Heart attack
- Myocarditis (inflammation of the heart muscle)
- Arrhythmias (heart rhythm disorders)
- Cardiomyopathy (enlargement of the heart muscle)



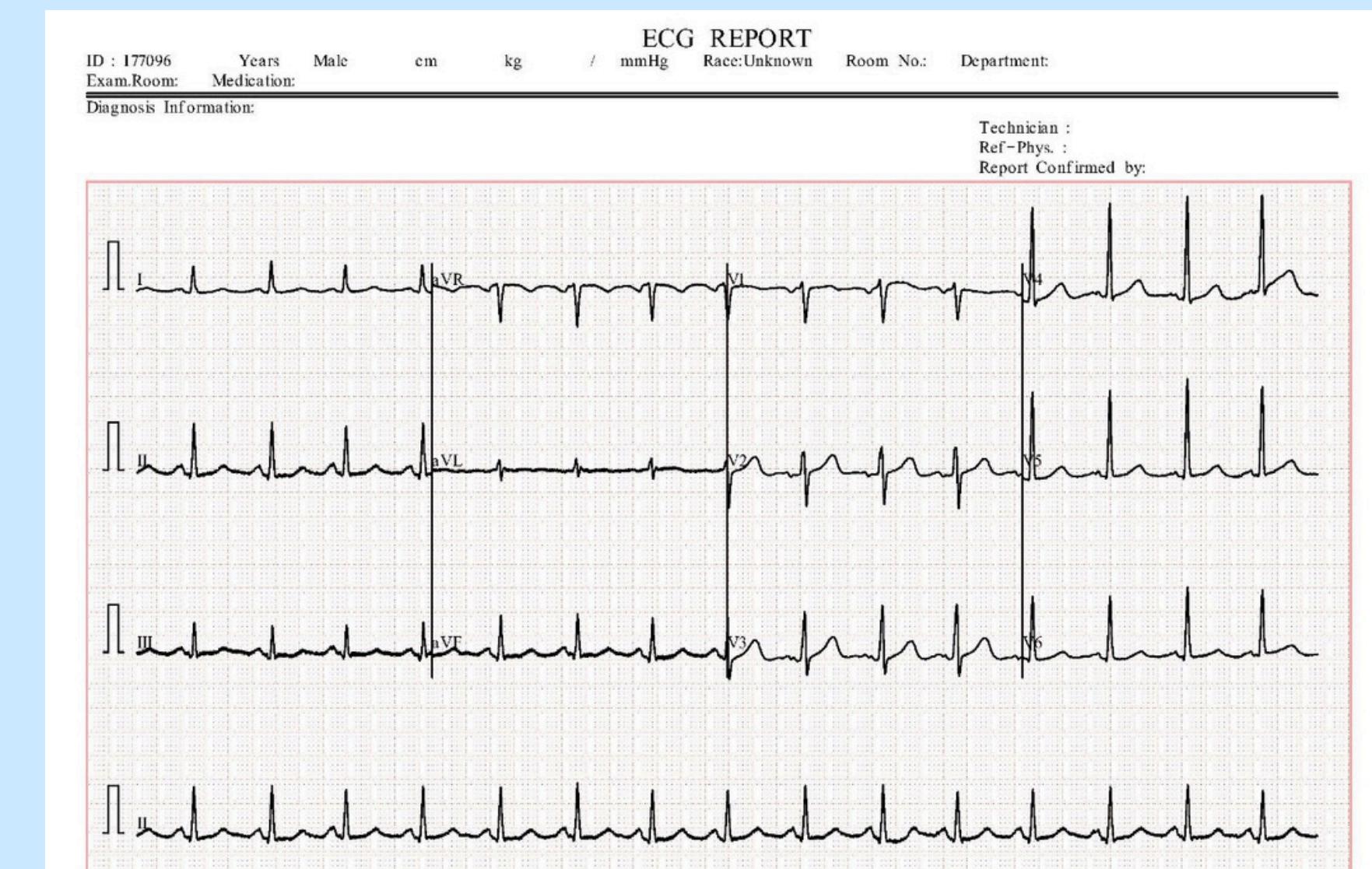
02

# Motivation



★ The motivation behind developing an application using ECG image for diagnosing heart diseases and COVID-19 is to enhance early diagnosis and provide effective healthcare.

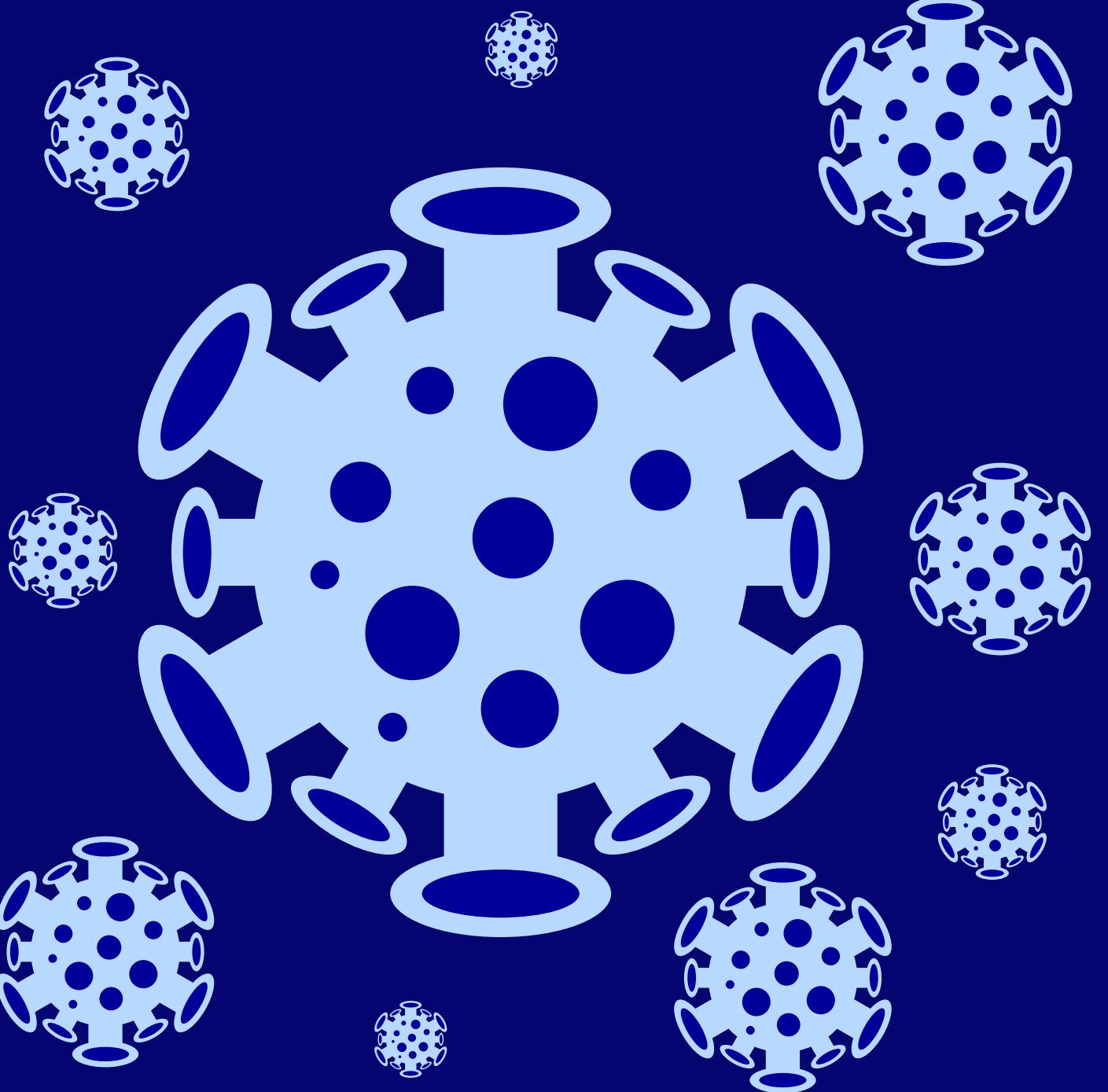
★ This technology aids in identifying precise changes in heart activity, capturing early signs of heart diseases, and understanding the cardiac effects of the coronavirus.



- ★ This contributes to quicker treatment decisions, improving recovery chances, and enhancing preventive measures
- ★ The goal is to develop a simple and effective diagnostic tool using artificial intelligence technology, to assist doctors in diagnosing cases more quickly and accurately.

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## PROBLEM STATEMENT



One of the problems users face when they need to diagnose whether they are infected with the coronavirus or have a heart condition is that they have two protocols to choose from.

01

The first protocol is **PCR**, which provides quick but less accurate results.

02

The second protocol involves **lung imaging**, which is costly, time-consuming, and requires a doctor's intervention



Both protocols have their advantages, but they also have drawbacks. Therefore, it is important for us to develop a new protocol that assists users in diagnosis.

04

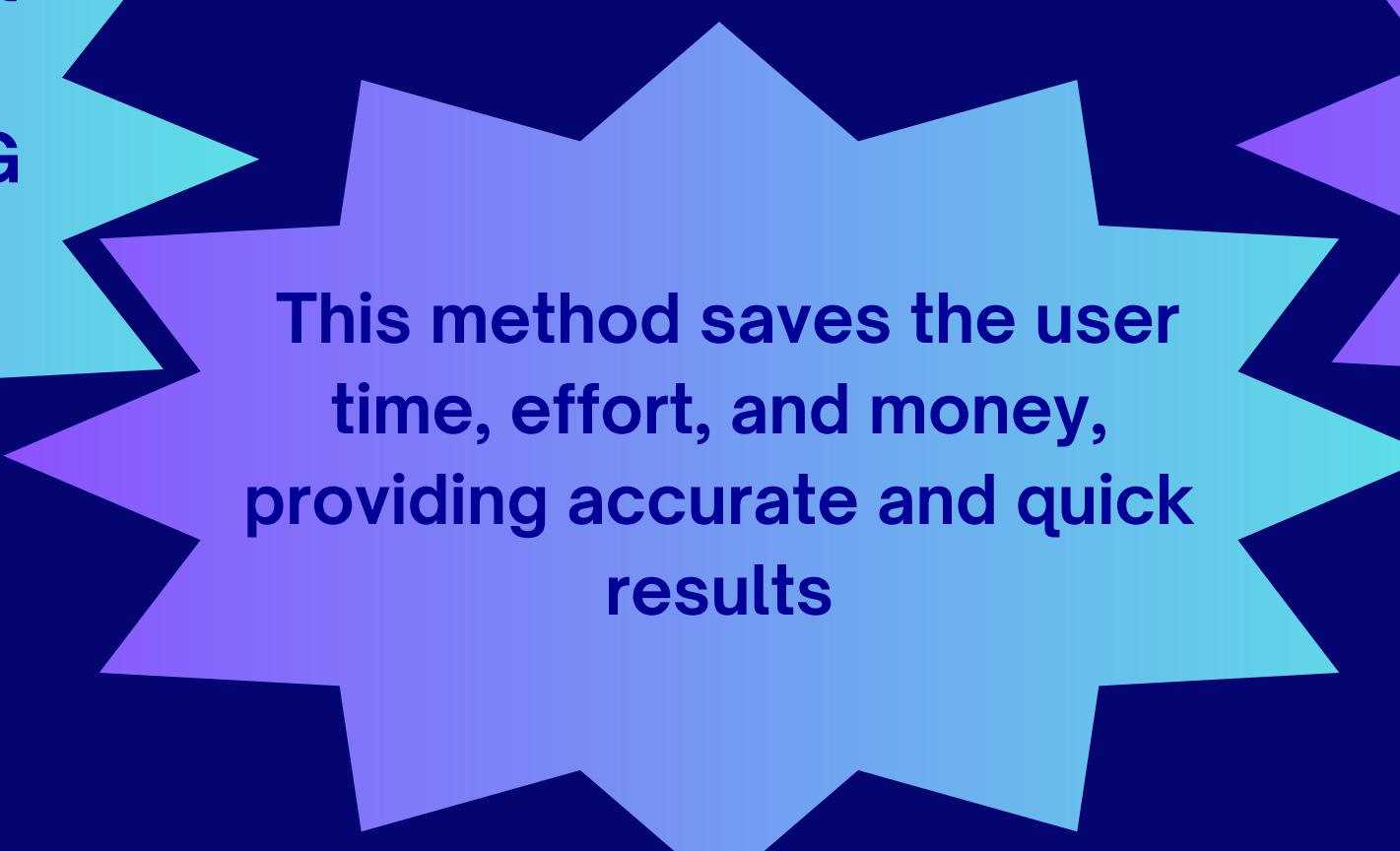
## PROBLEM SOLUTION



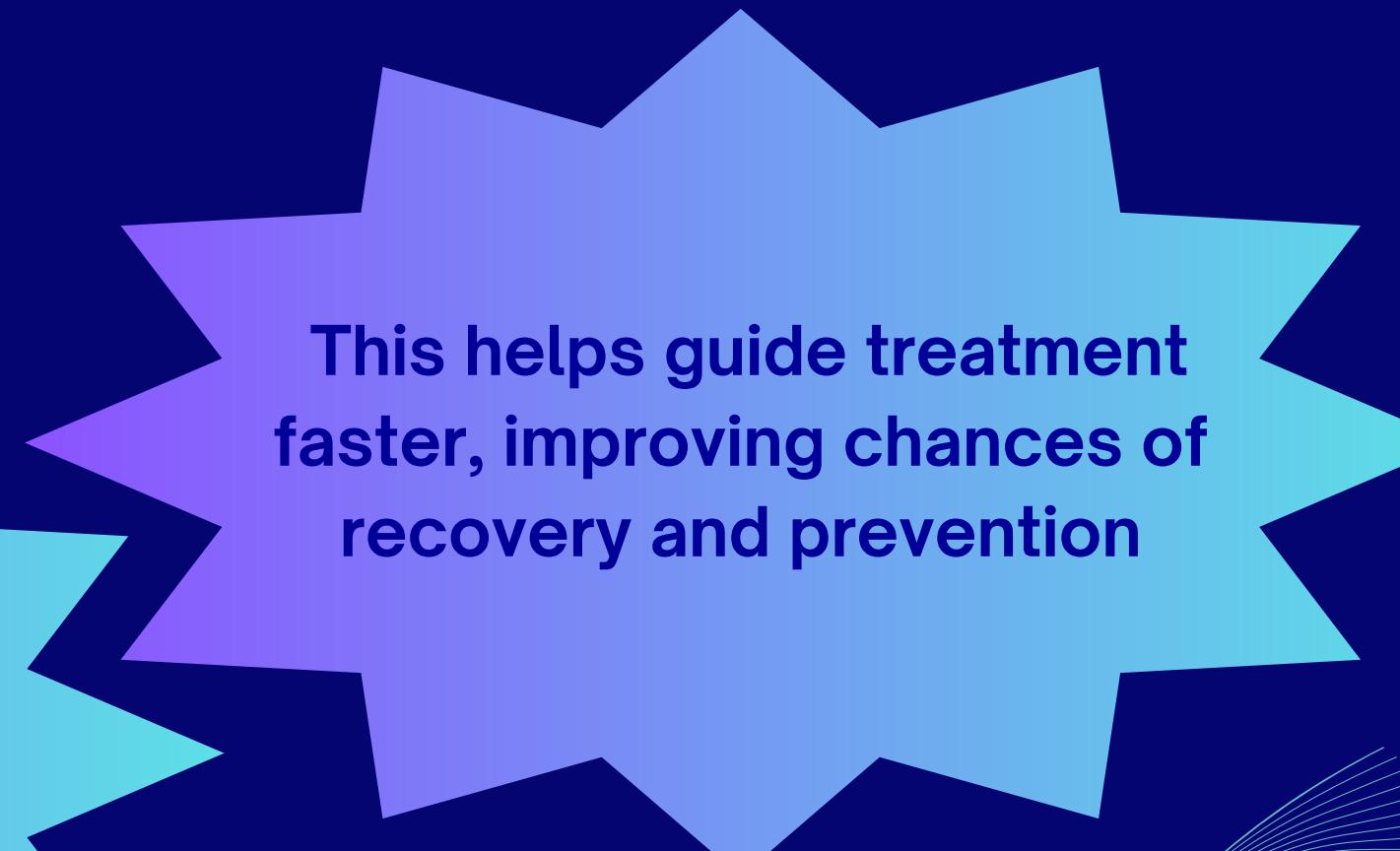
# SOLUTION



we developed a website that assists users in diagnosing these diseases by using ECG images



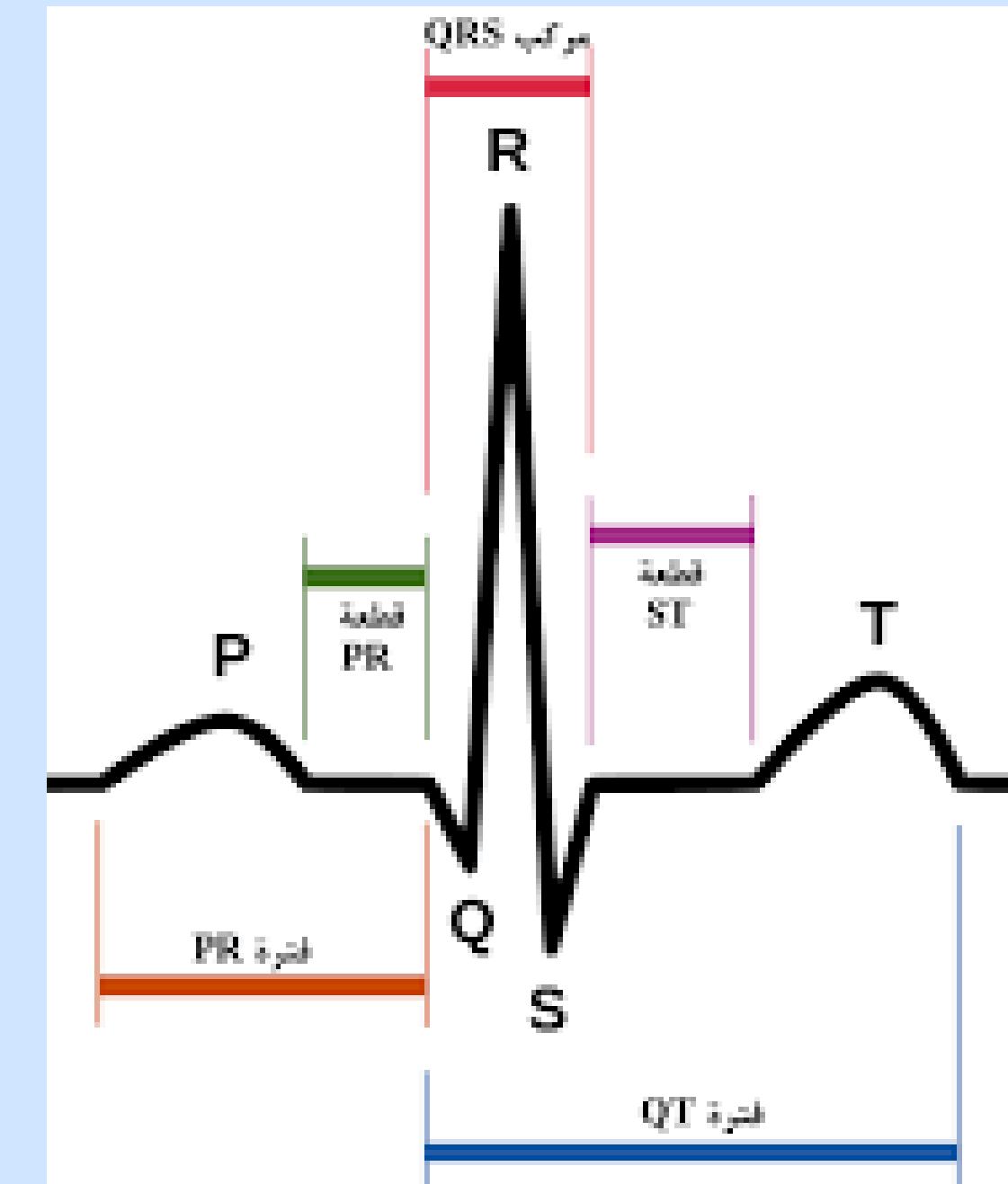
This method saves the user time, effort, and money, providing accurate and quick results



This helps guide treatment faster, improving chances of recovery and prevention

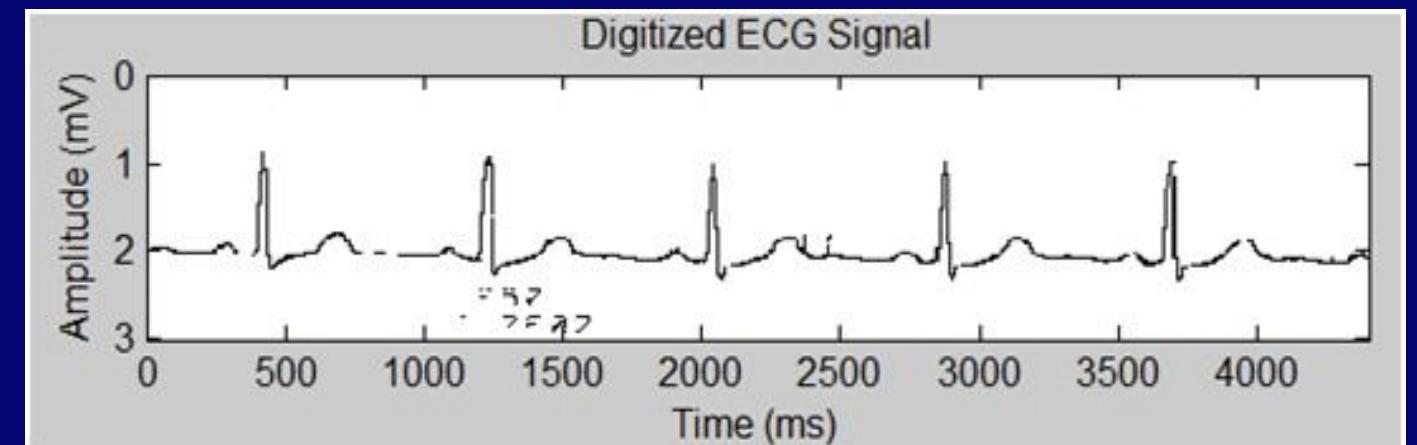
# Electrocardiogram (ECG Signals)

- ★ **(ECG)** signals are considered one of the most important attributes for continuous monitoring of the human health.
- ★ The **ECG** signal consists of five main peaks which are the **P**, **Q**, **R**, **S**, and **T**.
- ★ The **ECG** technology depends on the electrical impulses of the heart.



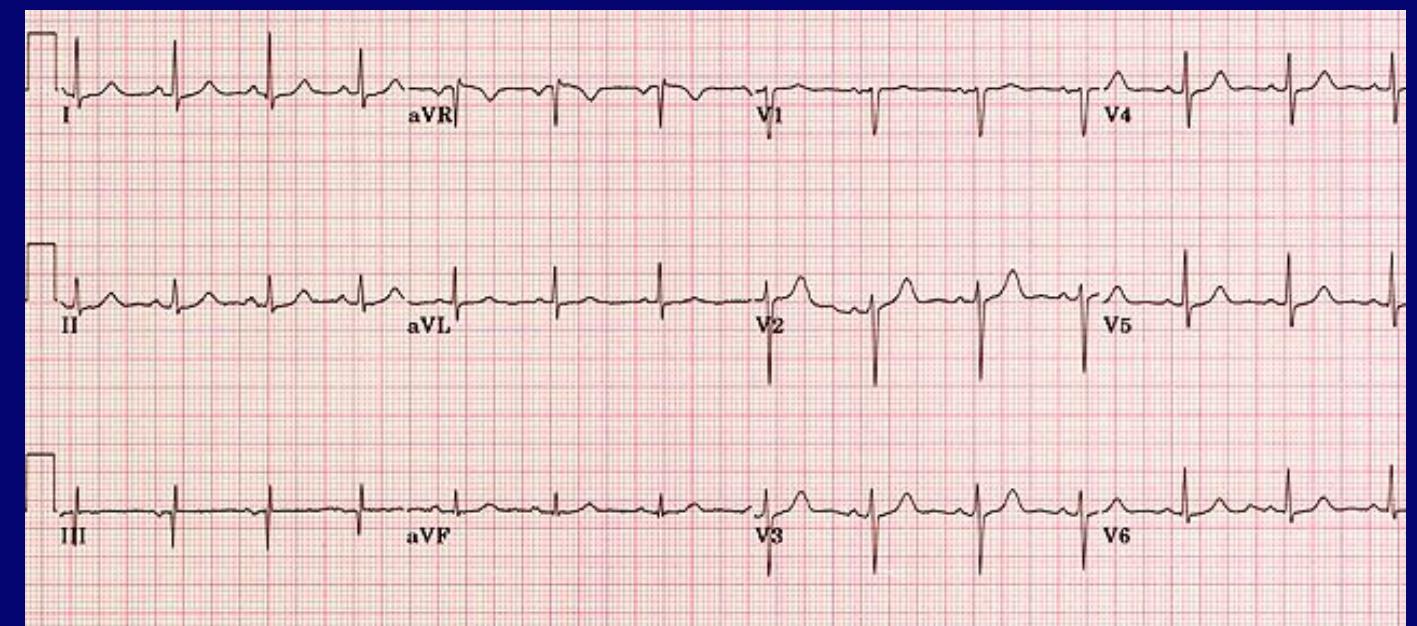
# Electrocardiogram (ECG Image)

★ ECG can be represented in various shapes. One of these shapes is the digitized form of the ECG.



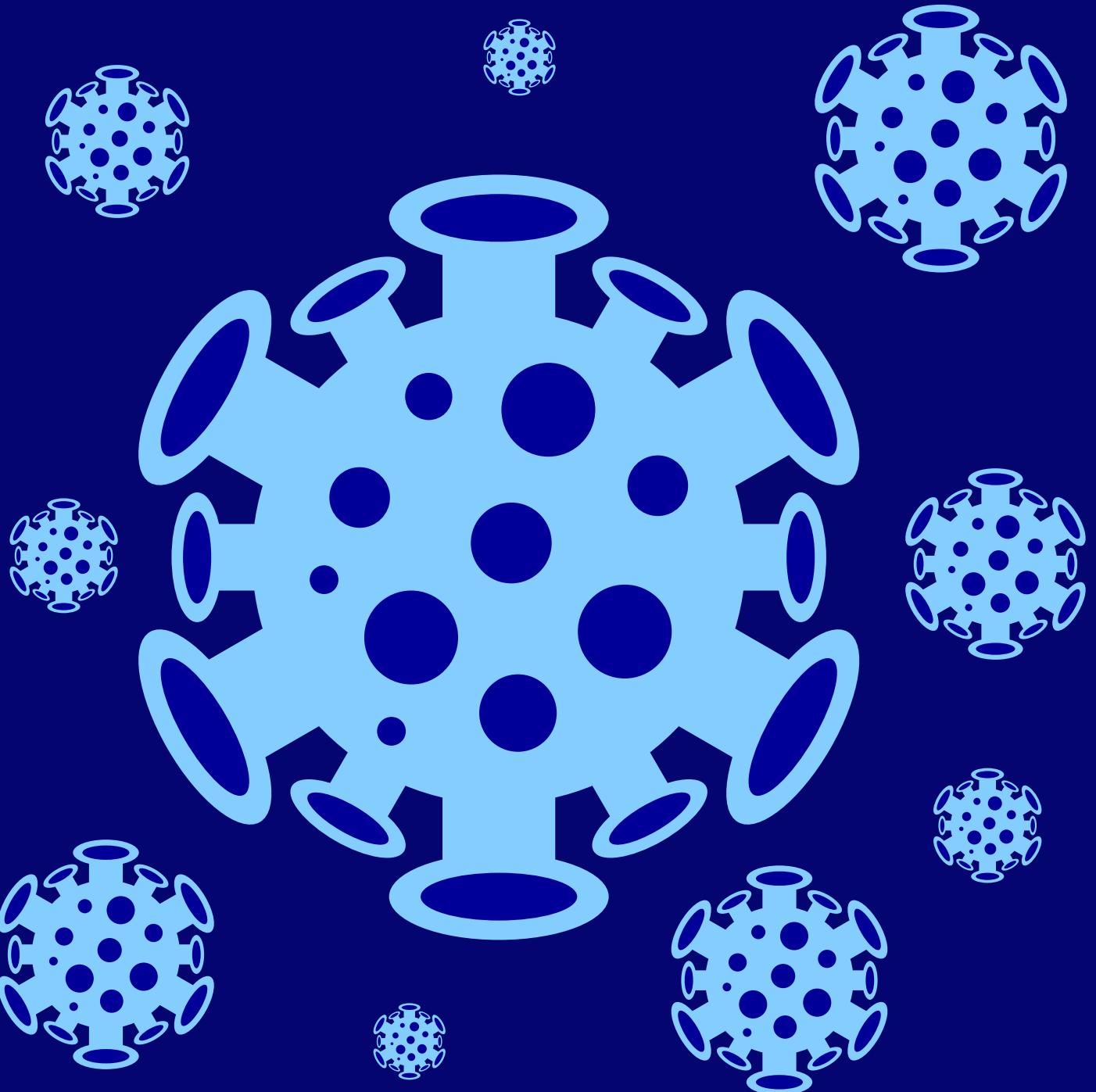
★ Another shape or form that describes the ECG is the ECG graph or the ECG tracing.

★ ECG paper reports are printed in the form of graph paper to achieve an accurate interpretation



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# Related work



Authors	No classes and leads	Types of ECG classes	Number of ECG image Reports or Recorded Images	Methodology	Results
Du et al. 2020	<b>20 classes</b> <b>12- ECG leads</b>	<b>20 ECG class types</b>	1 <sup>st</sup> dataset: 27,820 image reports. 2 <sup>nd</sup> dataset: 33000 image reports	Discovery of weak supervised and spatial attention part + recurrent label inference	1 <sup>st</sup> dataset: A = 79.23% F1-Score: 73.88% 2 <sup>nd</sup> dataset: A= 90.42% F1-Score: 86.87%
Xie et al. 2021	20 classes 12- ECG leads	Normal, Stroke	98 ECG image reports	Proposed Dense Net architecture	Train: 90 Test: 8 A = 85.82%
Gliner et al. 2020	8-classes 12- ECG leads	AF, I-AVB, LBBB, RBBB, PAC, PVC, STD, and STE	<b>41830</b> <b>Digital and Image leads</b>	CNN-ima and CNN-dig	Training and validation = 86% Testing = 14% A = 88%
OurTeam	5 Class	Normal Abnrmal Mycrocardial History of Microcardial Covid_19	8350 Images	Mask and CNN Modal (inception_v3)	Train=97.5% Test=97.2% Validation=97.7%

06

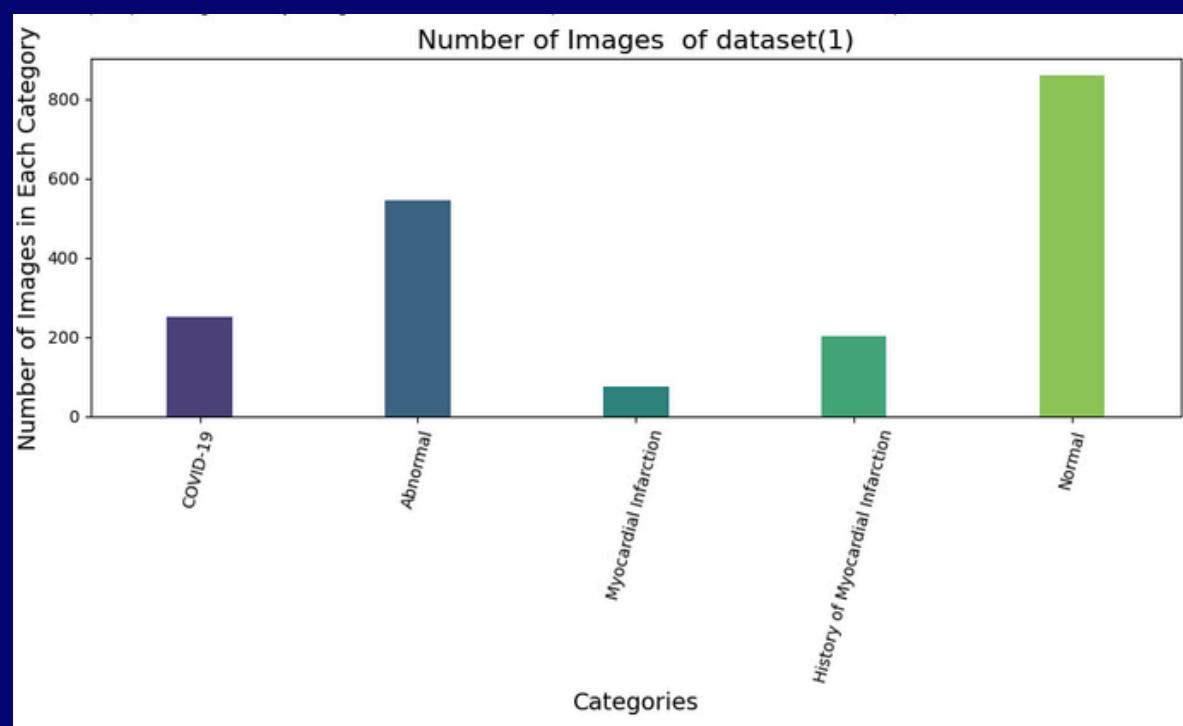
# DATASET



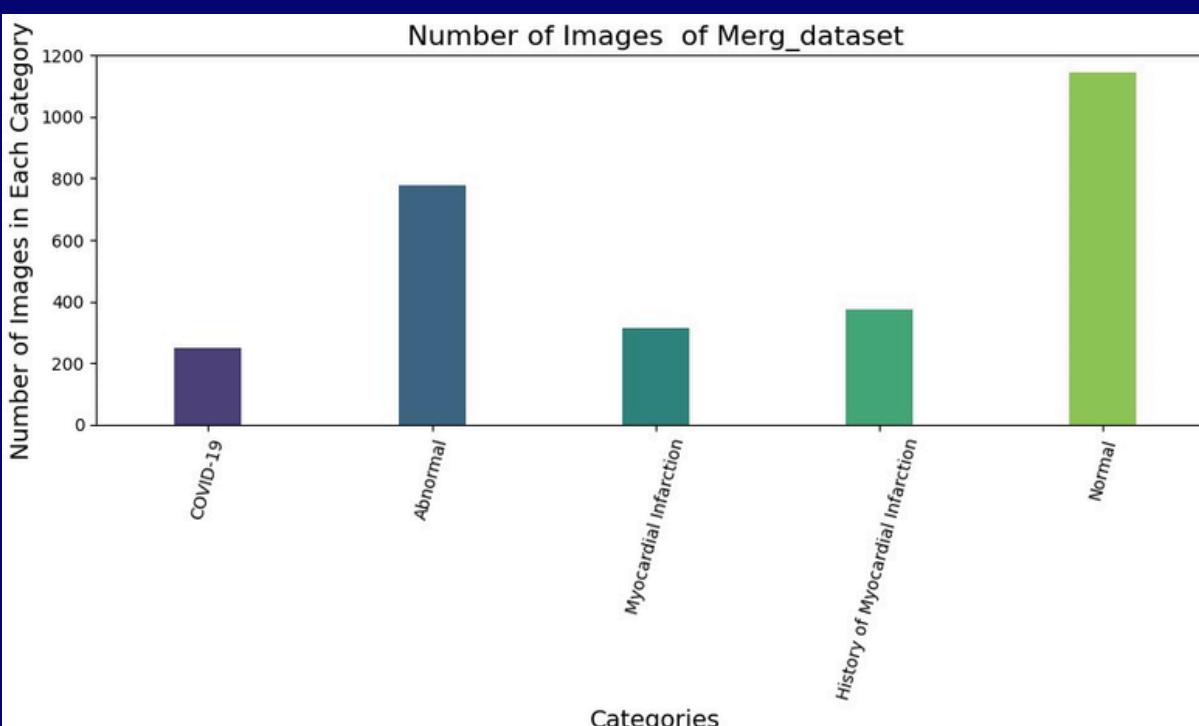
# Dataset Information

Our dataset consists of five types of ECG (Electrocardiogram) images.

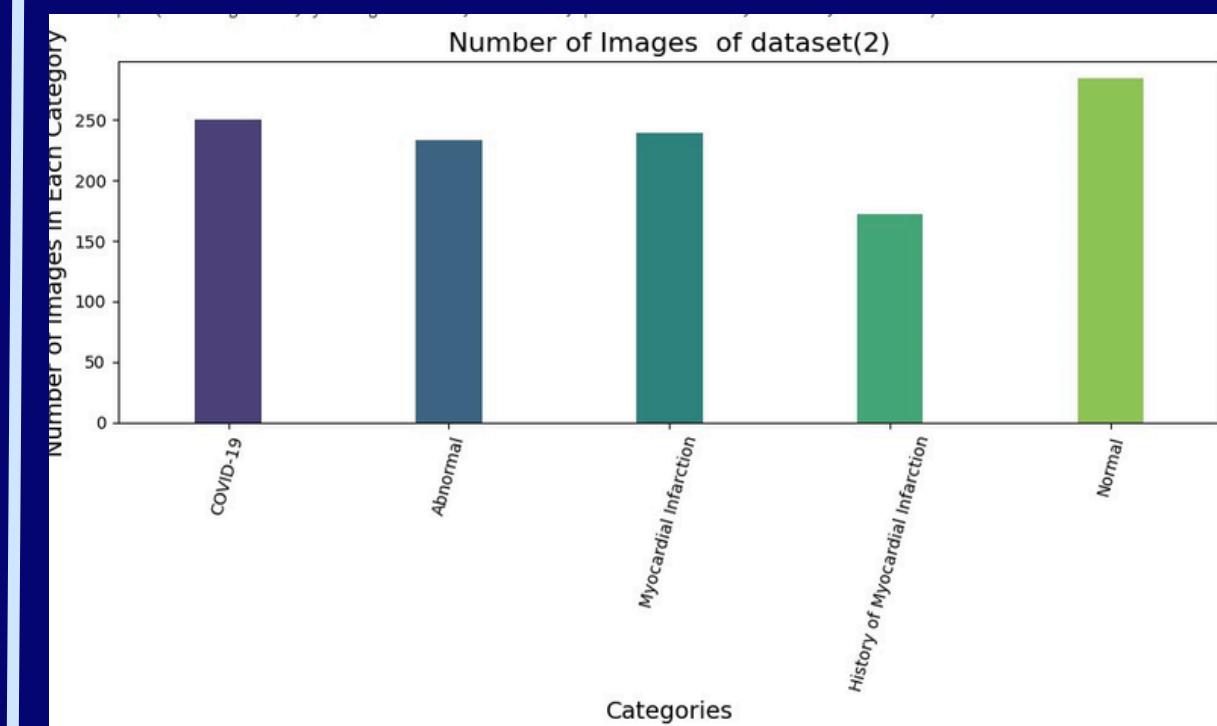
Dataset(1)



Merg Dataset



Dataset(2)



Total Number of ECG Images is 1932

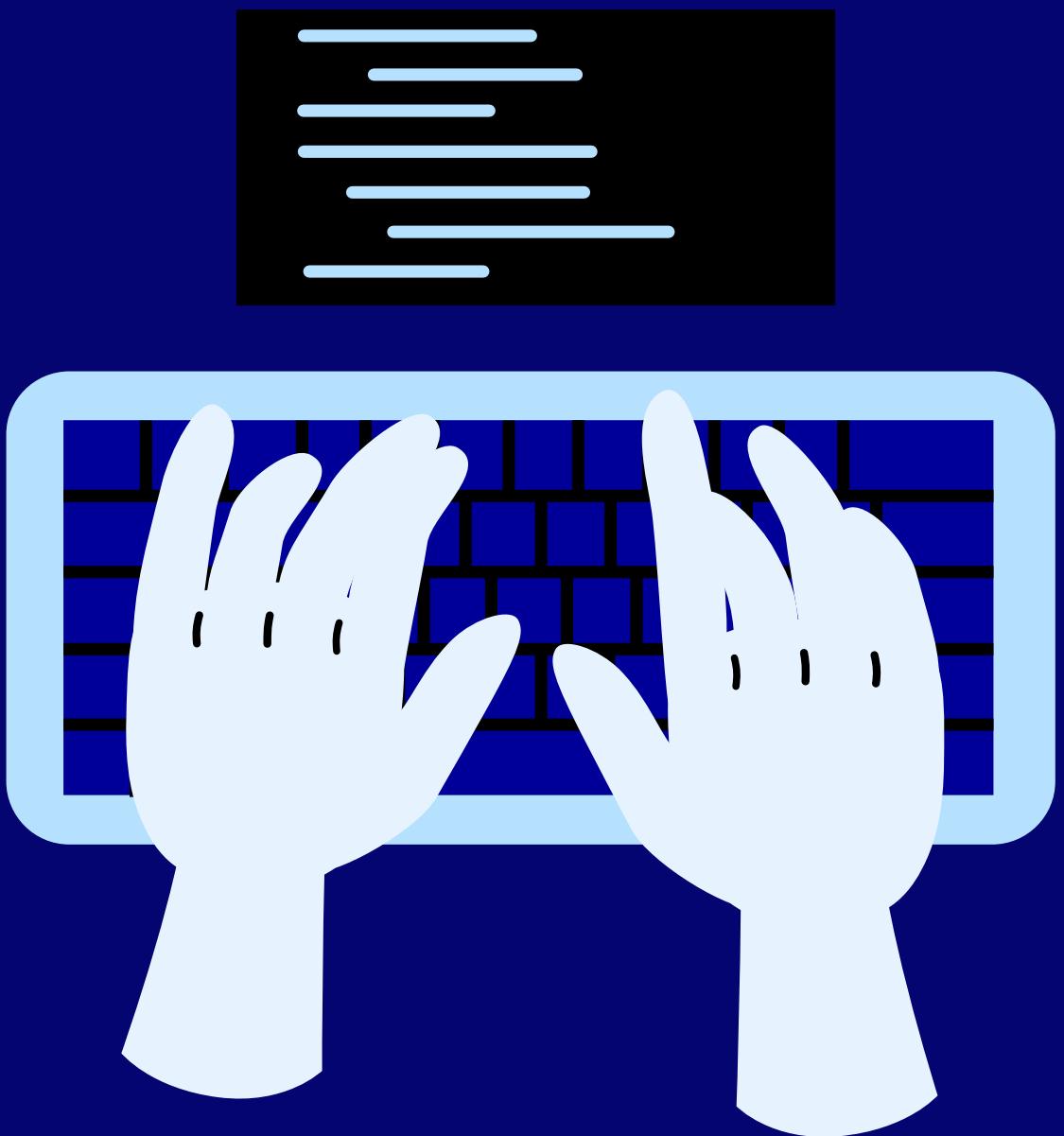
Total Number of ECG Images is 2860

Total Number of ECG Images is 1178

- This dataset consists of ECG images collected from two countries China and Pakistan.

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# IMPLEMENTATION



# Image preprocessing

**is the first step in implementing the model, where we prepare the data by applying image filters to improve the quality and suitability of the images for the deep learning algorithm.**

# Image preprocessing



# Image Preprocessing

## 1-Remove Noise

Removing noise from images is a crucial step in image processing to improve the overall quality and clarity of an image

Noise in images refers to random variations or unwanted disturbances in pixel values, often introduced during image acquisition , transmission, or processing.

To enhance the accuracy of our image processing, we must address the noise present in the header and footer. This noise can take the form of text, logos, or other visual elements that are not part of the main image content.



# TECHNOLOGY USED FOR REMOVING NOISE



we use  
**Bilateral Filtering** to  
remove noise

01

is a non-linear method that smoothens

02

the image while preserving edges.

03

It considers both spatial closeness and intensity similarity.

# Image Preprocessing

2-Remove  
Background

This process is essential to enhance the visibility of key information within ECG images, improve analysis accuracy, and facilitate the classification of patterns present in ECG.

Removing the background is necessary to enhance the performance of models.

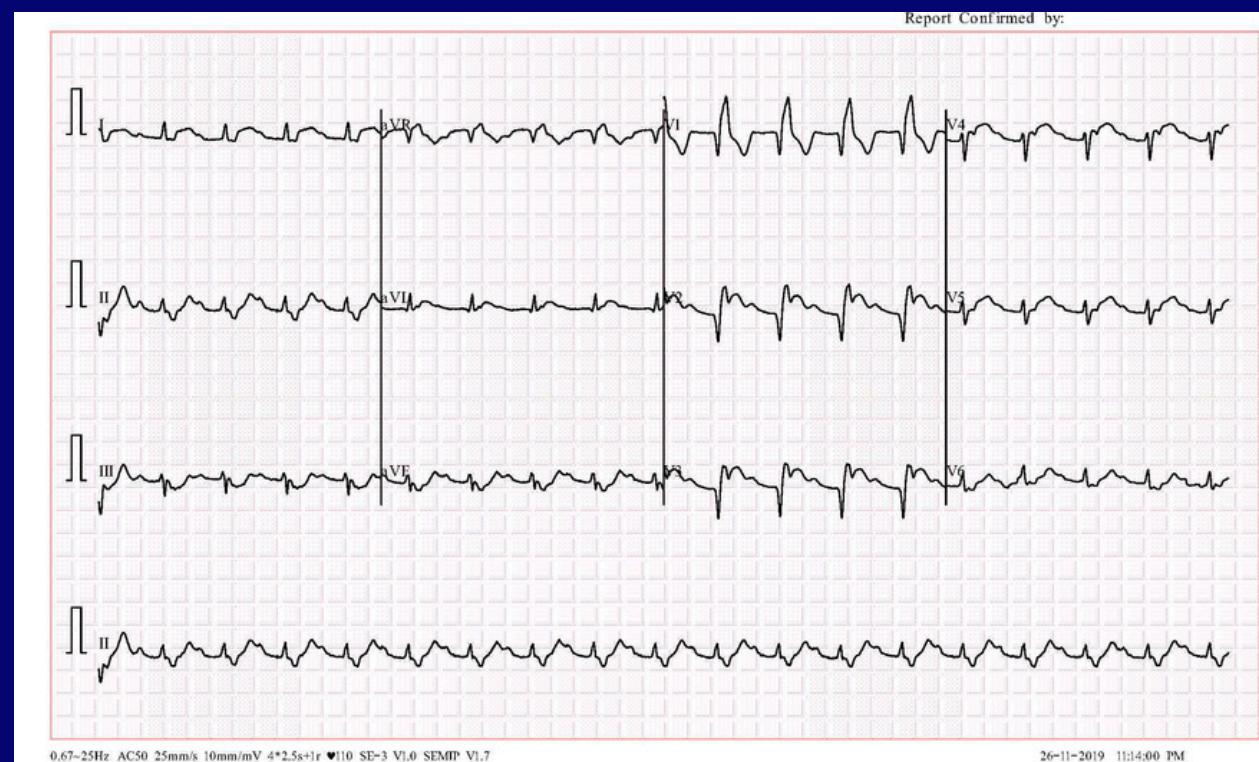
Technology used to  
Removing background

## 1- Segmentation

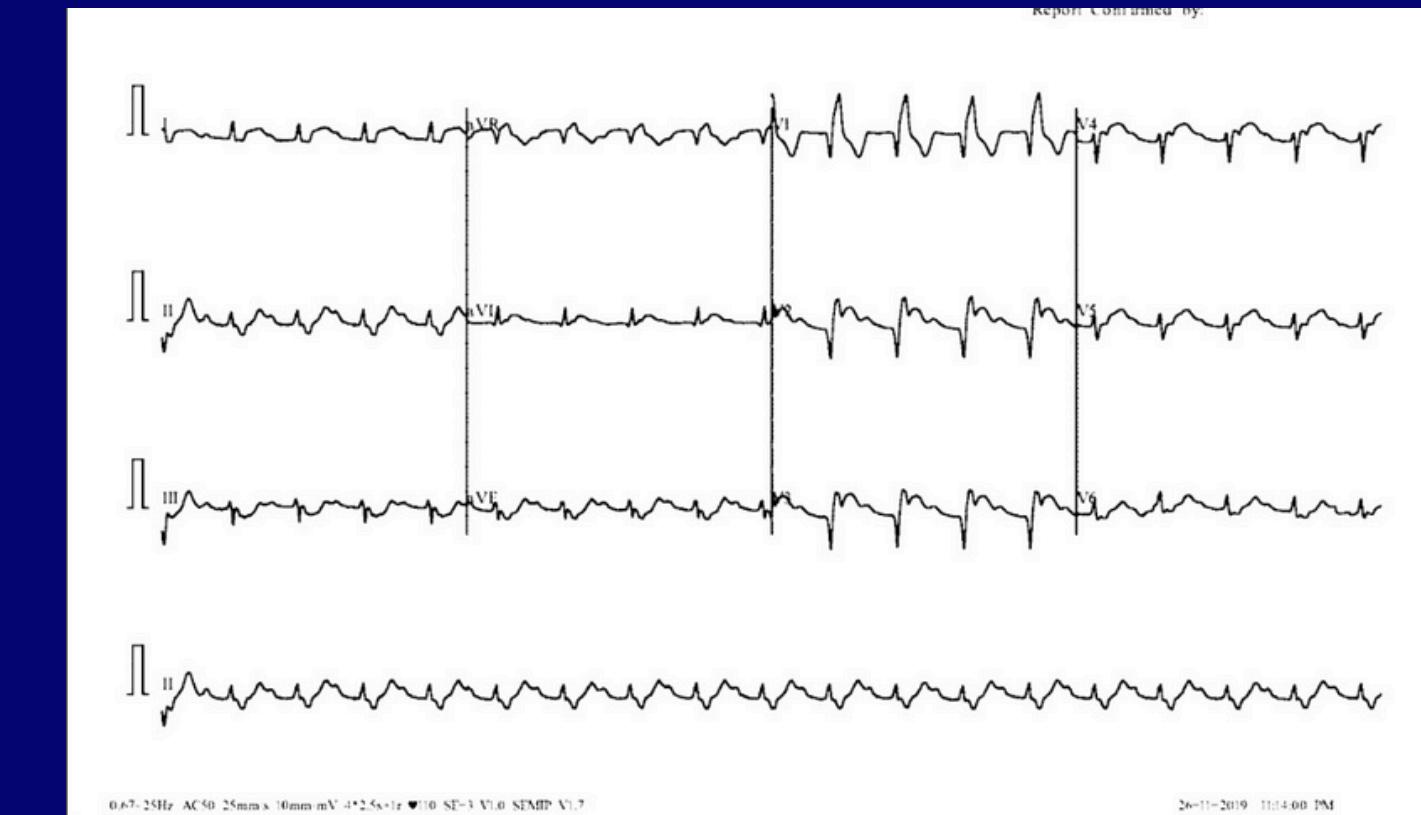
is attempts to partition the pixels of an image into groups that strongly correlate with the objects in an image Then it's easy to extract it from a background

In the process of segmentation, type of thresholds are used

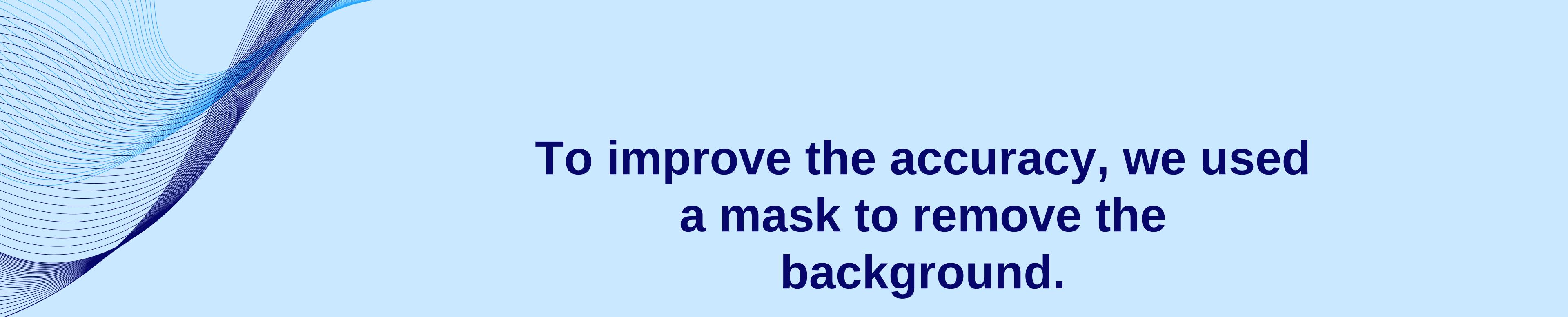
binary with Otsu's



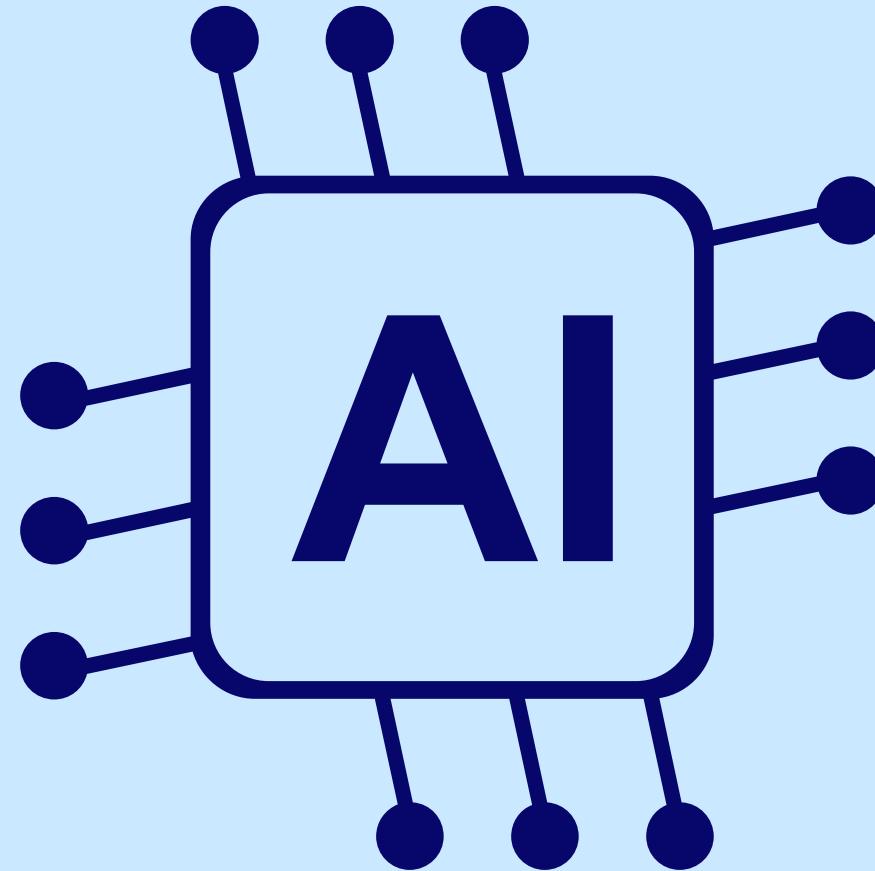
Before



After



To improve the accuracy, we used a mask to remove the background.



## 2- mask

is a binary image used to identify specific parts of another image. The values in the mask are either 0 (black) or 255 (white), where white represents the areas we want to keep or process, and black represents the areas we want to ignore or exclude.



# steps to create the mask

01

**Define Color Bounds:** This helps us identify and isolate the white areas in the image which we consider as the background.

02

**Create a Mask:** we create a mask that highlights the white areas. This mask will be used to separate the background from the foreground

04

**Invert the Mask :** To focus on the foreground, we invert the mask. This will allow us to later combine the foreground with a new background

05

**Prepare Background :** We prepare a white background image that will replace the original background.

03

**Morphological Operation** :We then apply a morphological operation to refine our mask, removing noise and small white points

06

**Apply Mask to Foreground:** Using the inverted mask, we apply it to the original image to keep only the foreground

07

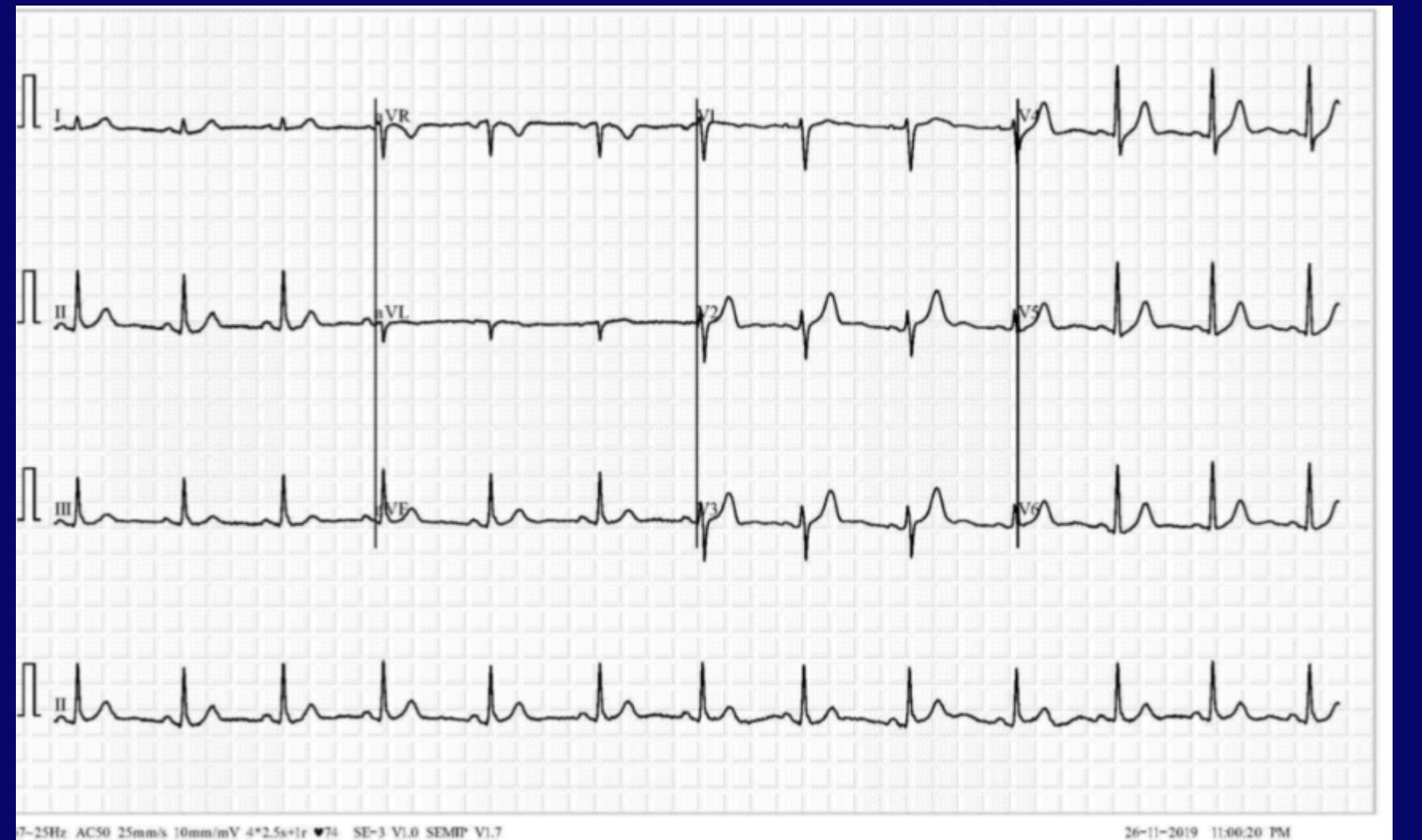
**Apply Mask to Background:** We then apply the inverted mask to our white background image.

08

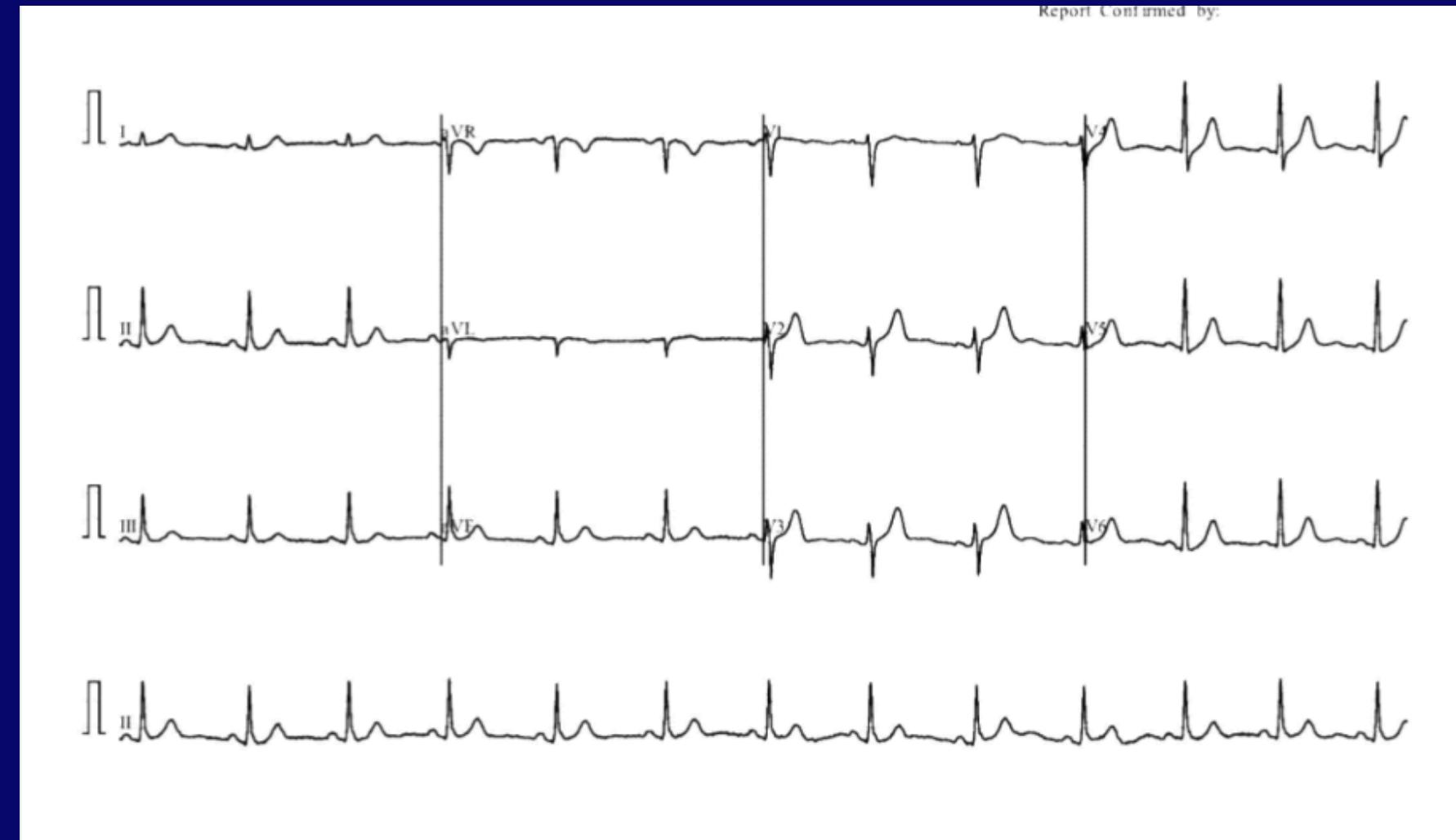
**Combine Images :** Finally, we combine the foreground and the new background to produce the final image without the original background.

09

**Save the Final Image :** We save the final image with the background removed, completing our background removal process



Before



After

# Image Preprocessing

## 3. Resizing

**Image resizing adjusts the dimensions of an image for consistency and efficiency in machine learning models, enhancing performance and resource management.**

## 4. Rescaling

**Rescaling is adjusting data to a common scale, crucial for equal feature influence in machine learning. It enhances algorithm performance and ensures fair analysis.**

# Image Preprocessing

## 5. Data Augmentation

Deep learning technique requires much more training data than other machine learning approaches. In case where the data consists of images and not much data is available, image augmentation can be applied to increase the number of training examples and to avoid over fitting.

## • Techniques for Data Augmentation:



Image Data Generator Based On  
Geometric Transformations

Deep learning advanced

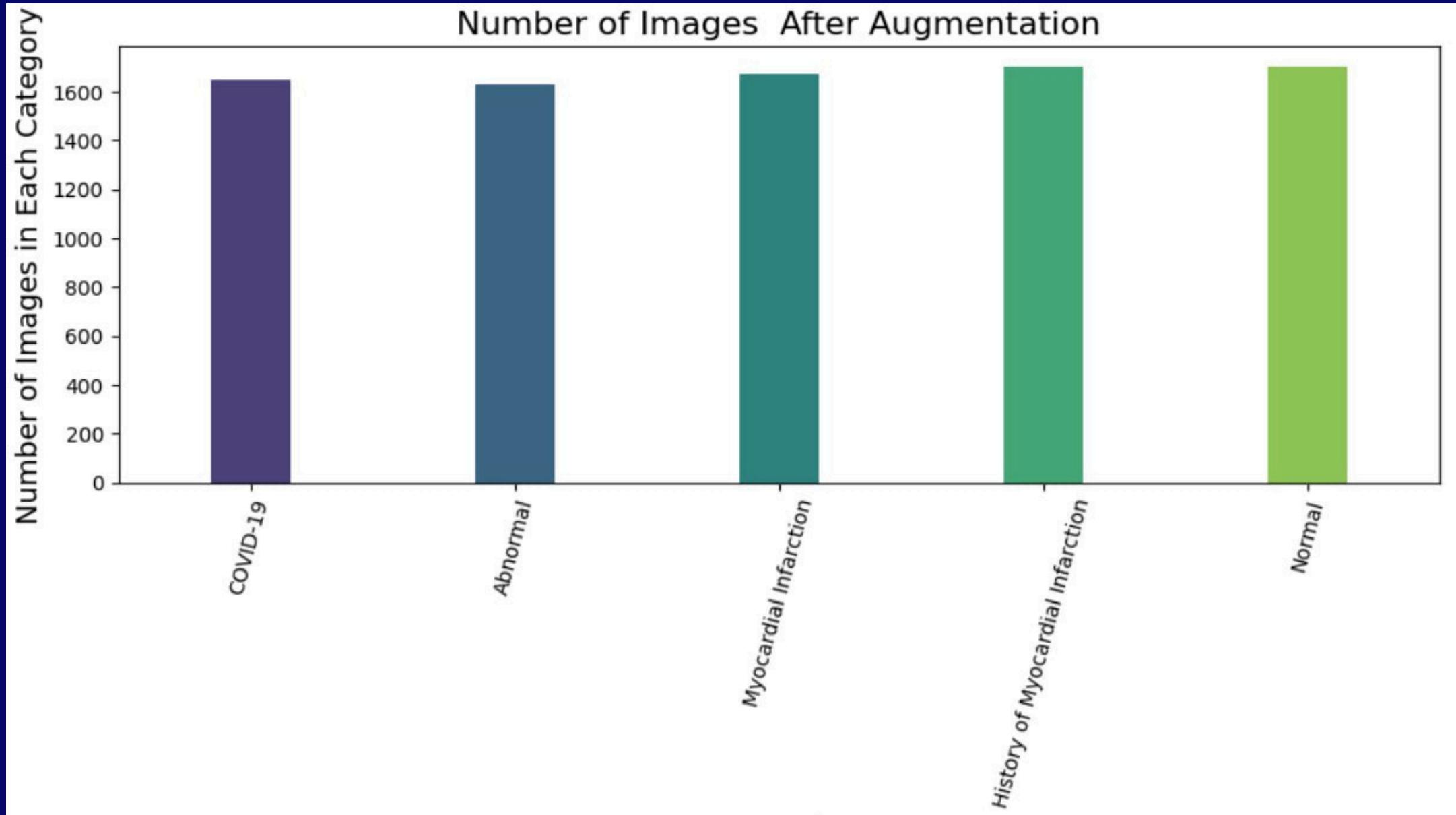


We don't have powerful devices on our team to support GAN technology, so we'll experiment with it in the second term.

rotation\_range=9  
zoom\_range=0.2  
brightness\_range=(0.5, 1.5)  
horizontal\_flip=True  
vertical\_flip=True  
shear\_range=0.085  
width\_shift\_range=0.085  
height\_shift\_range=0.085

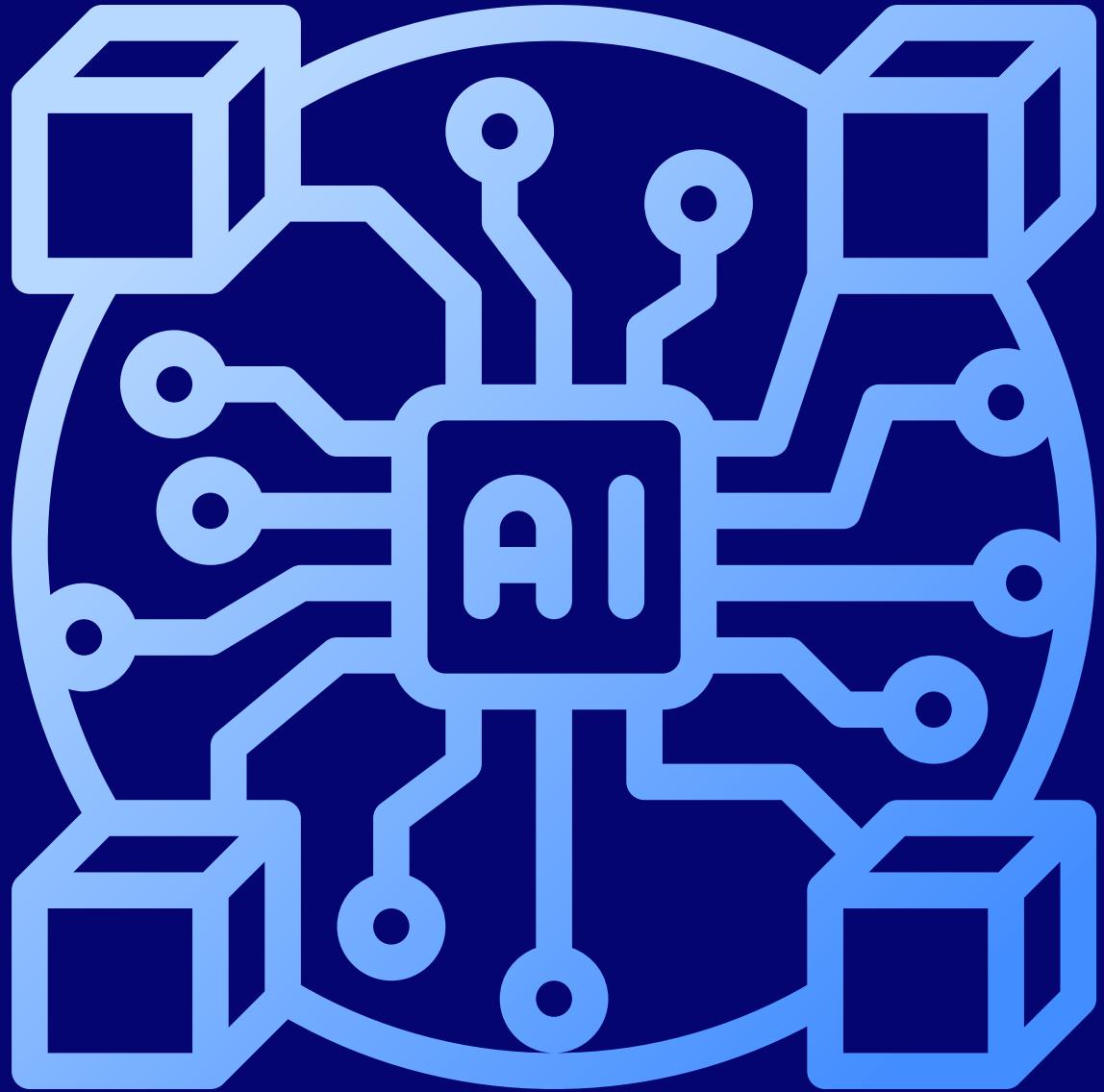
**GAN-based Augmentation:** Generative Adversarial Networks (GANs) generate synthetic data that closely resemble real samples, effectively expanding the dataset.

Total Number of  
ECG Images is  
8350

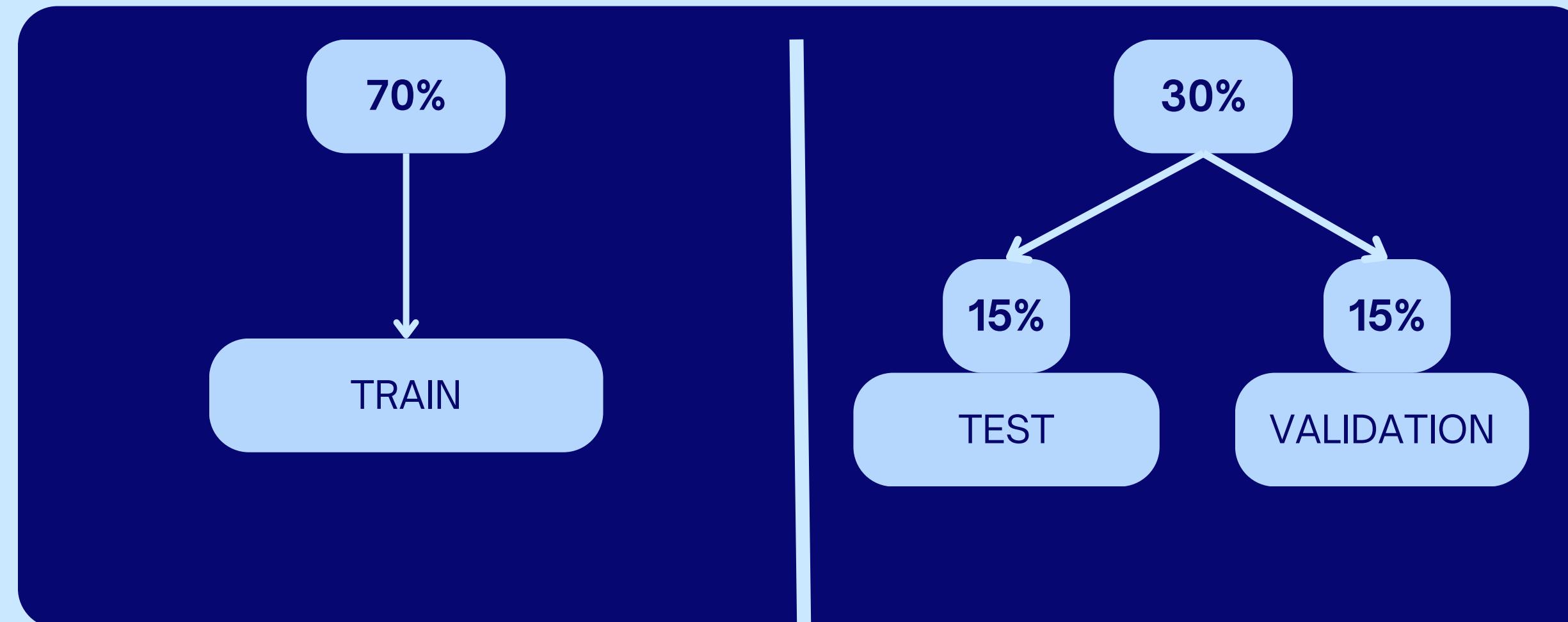


09

# Model Structure

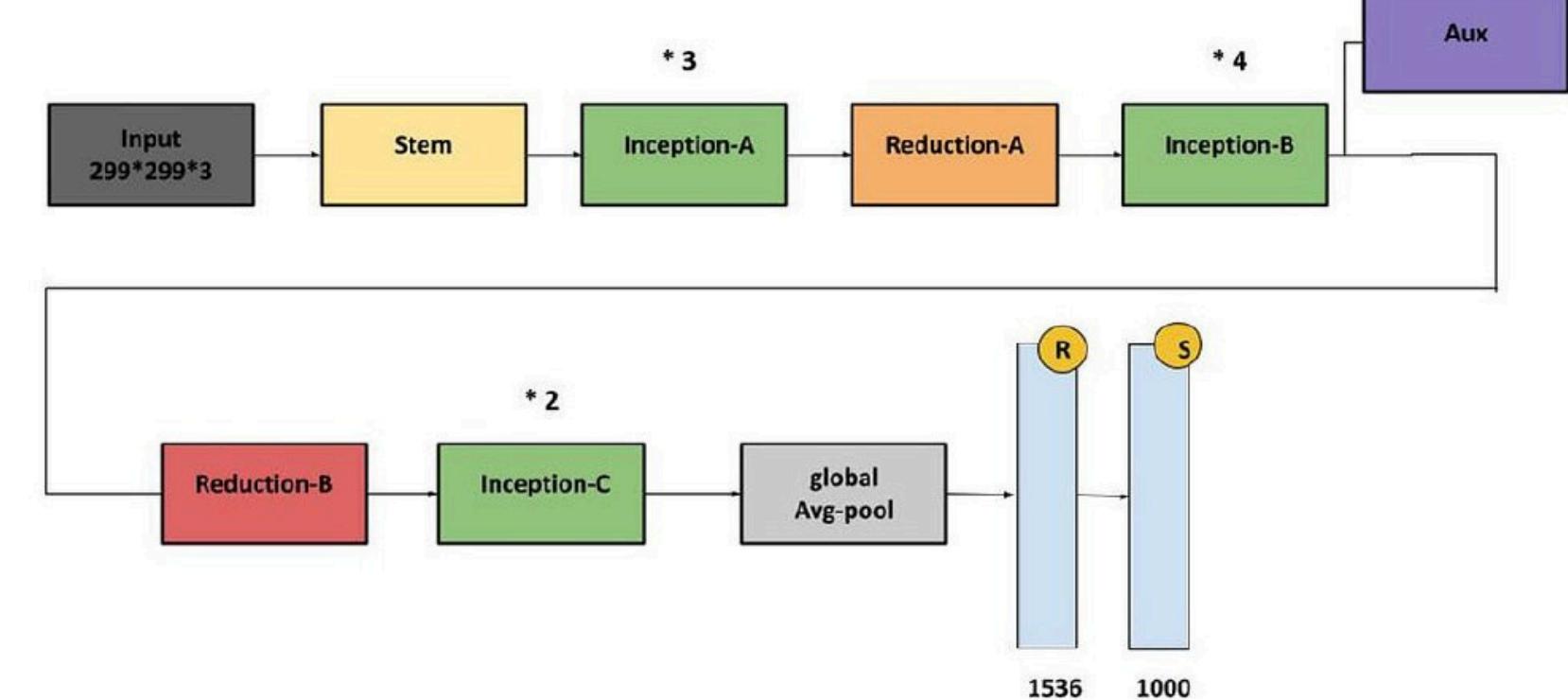


# WE DIVIDED THE DATA INTO THREE DATA SETS:



## Utilization Model

### Inception V3



the Inception V3 network, which is an advanced convolutional neural network (CNN) designed for image processing

# Model Structure

## input :

The input is an image with dimensions (299 \* 299 \* 3).

## Reduction-A:

A dimension reduction module of type A, aimed at reducing the spatial dimensions (height and width) while increasing the depth (number of channels)

## stem :

The initial part of the network processes the input data to prepare it for the subsequent stages.

- It includes multiple convolutional and pooling layers.

## Inception-B:

A series of Inception modules of type B, which include various convolutional operations to deepen the network and increase the complexity of the features learned.

## inception A

A series of Inception modules of type A, which combine different convolutional operations (such as (1\*1), (3 \* 3), and 5 \* 5)) to capture various features from the data.

## Auxiliary Classifier:

An auxiliary classifier used to provide additional training signals, helping to improve gradient flow during training.

- It consists of several convolutional and pooling layers, followed by a classification layer.

## **Reduction-B:**

A dimension reduction module of type B, further reducing the spatial dimensions and deepening the network

## **Inception-C:**

A series of Inception modules of type C, continuing to apply various convolutional operations to capture more features.

## **Global Average Pooling:**

A global average pooling layer, applied to reduce the spatial dimensions to 1, taking the average across each feature map.  
- Outputs a number of features equal to the number of channels.

## **Fully Connected Layers:**

Fully connected layers applied after global average pooling.  
- Include a final layer that outputs probabilities for each class (usually 1000 classes for image classification in ImageNet)

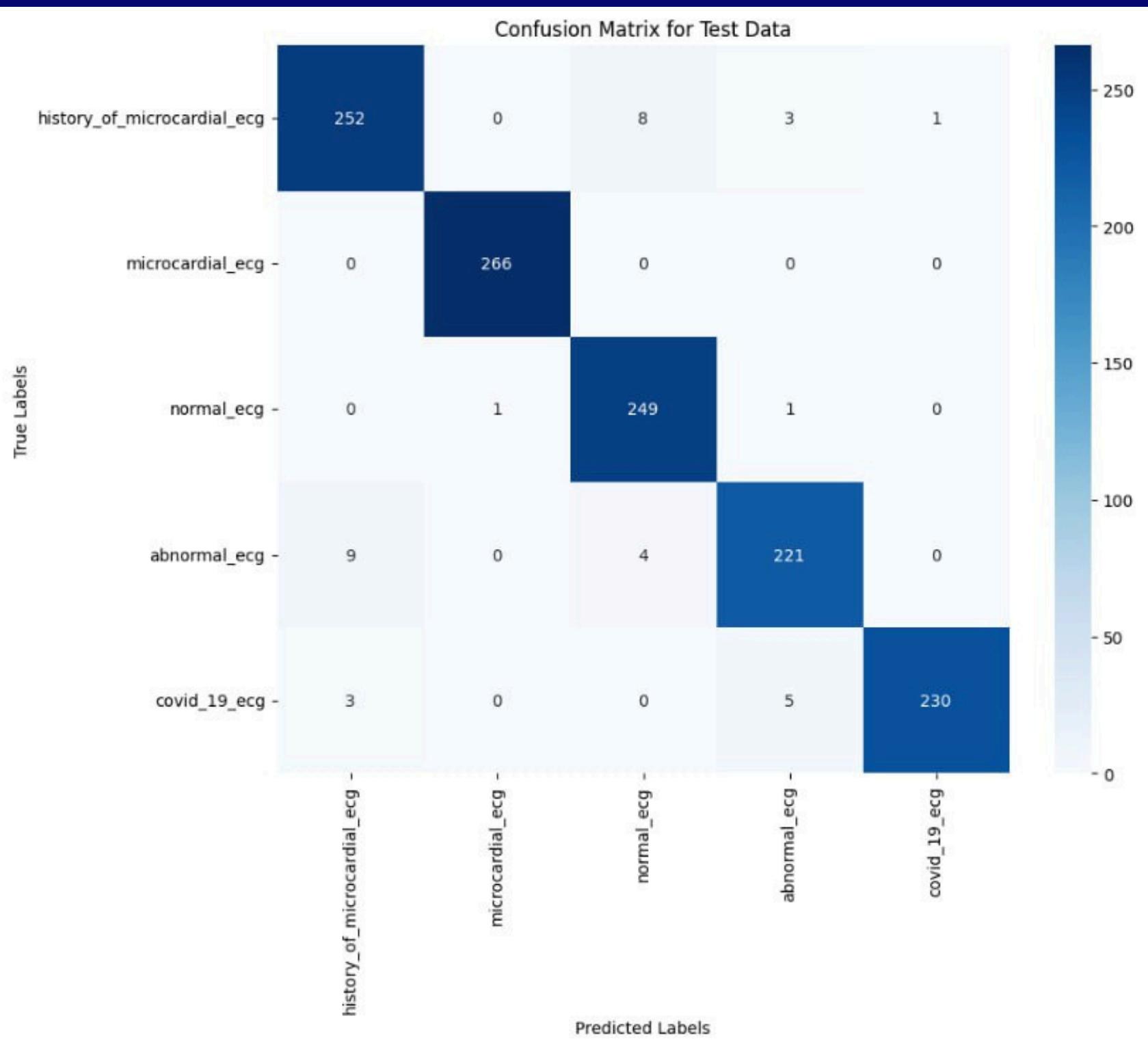
## **Dropout layer :**

use to remove neurons that have noise

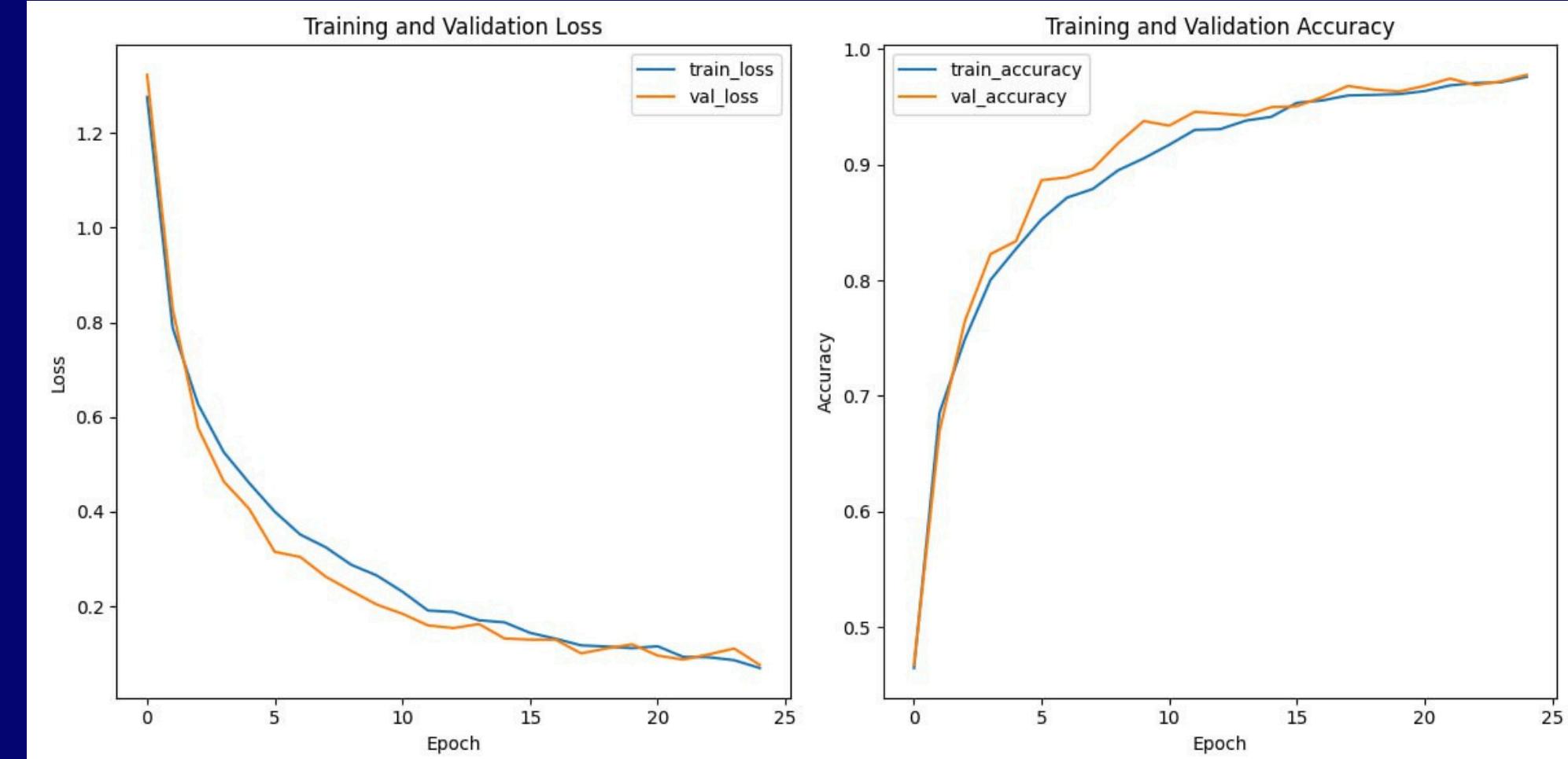
## **Last fully connected layer :**

use 5 neurons to make classification and use softmax classifier

## Confusion Matrix



## Loss & accuracy



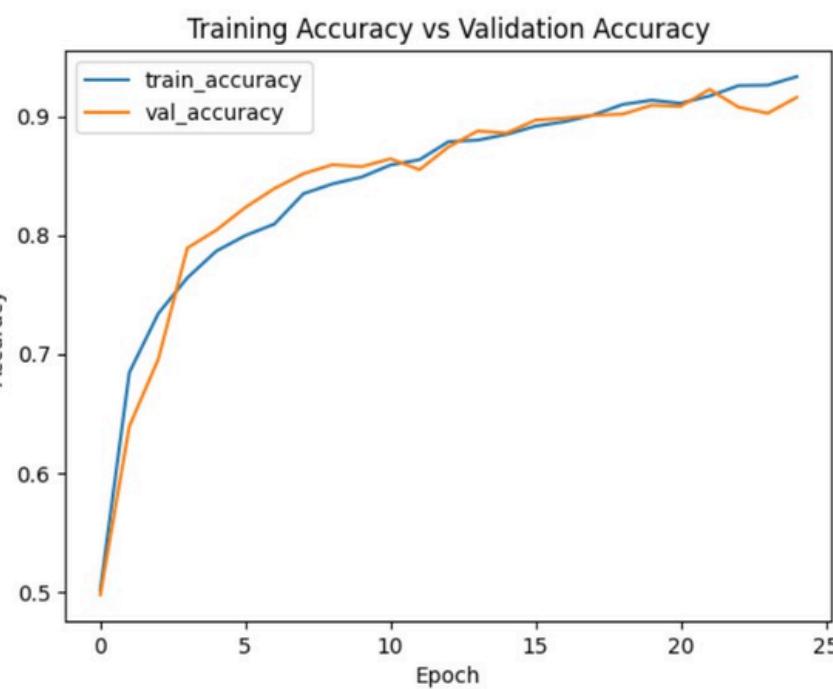
# The comparison between two dataset

DataSet.1



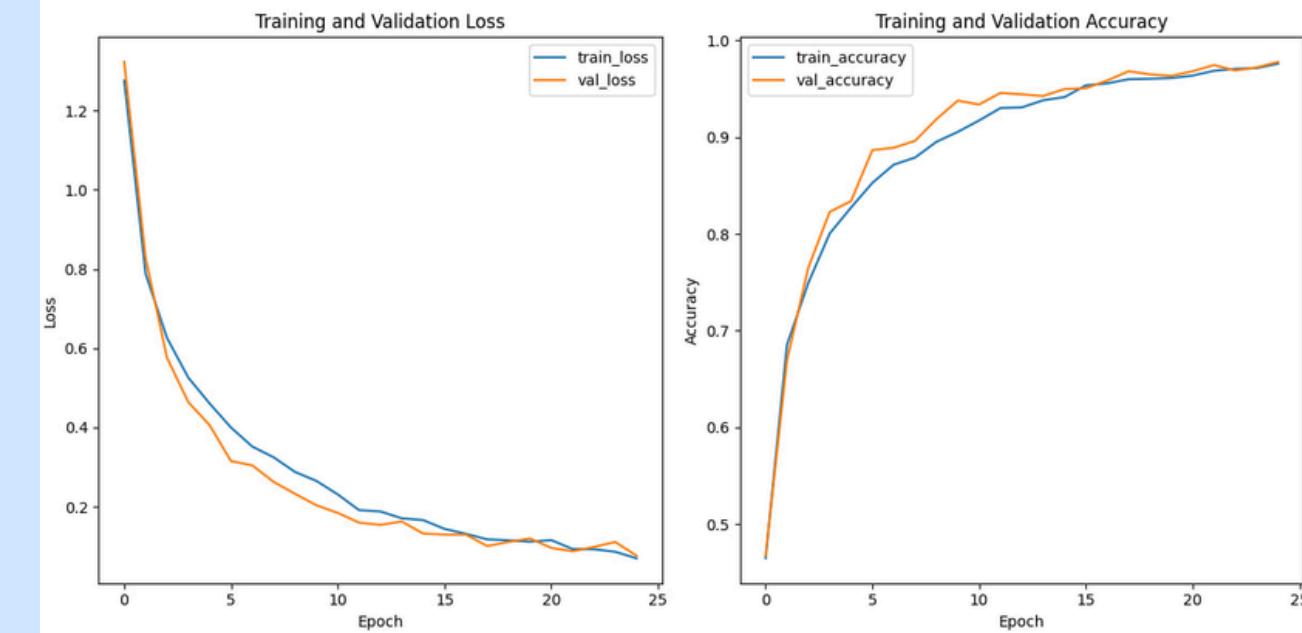
Train Accuracy:89%  
Test Accuracy:87%

MERG\_DataSet



Train Accuracy:93%  
Test Accuracy:91%

DataSet.2



Train Accuracy:97.5%  
Test Accuracy:97.2%

# Comprsion between different models

## Vgg\_19

Accuracy of train : **0.96%**

Accuracy of test:**0.95%**

Loss of train:**0.24**

Loss of test:**0.27**

## Resenet\_50

Accuracy of train : **0.95%**

Accuracy of test:**0.94%**

Loss of train:**0.13**

Loss of test:**0.14**

## Inception V3

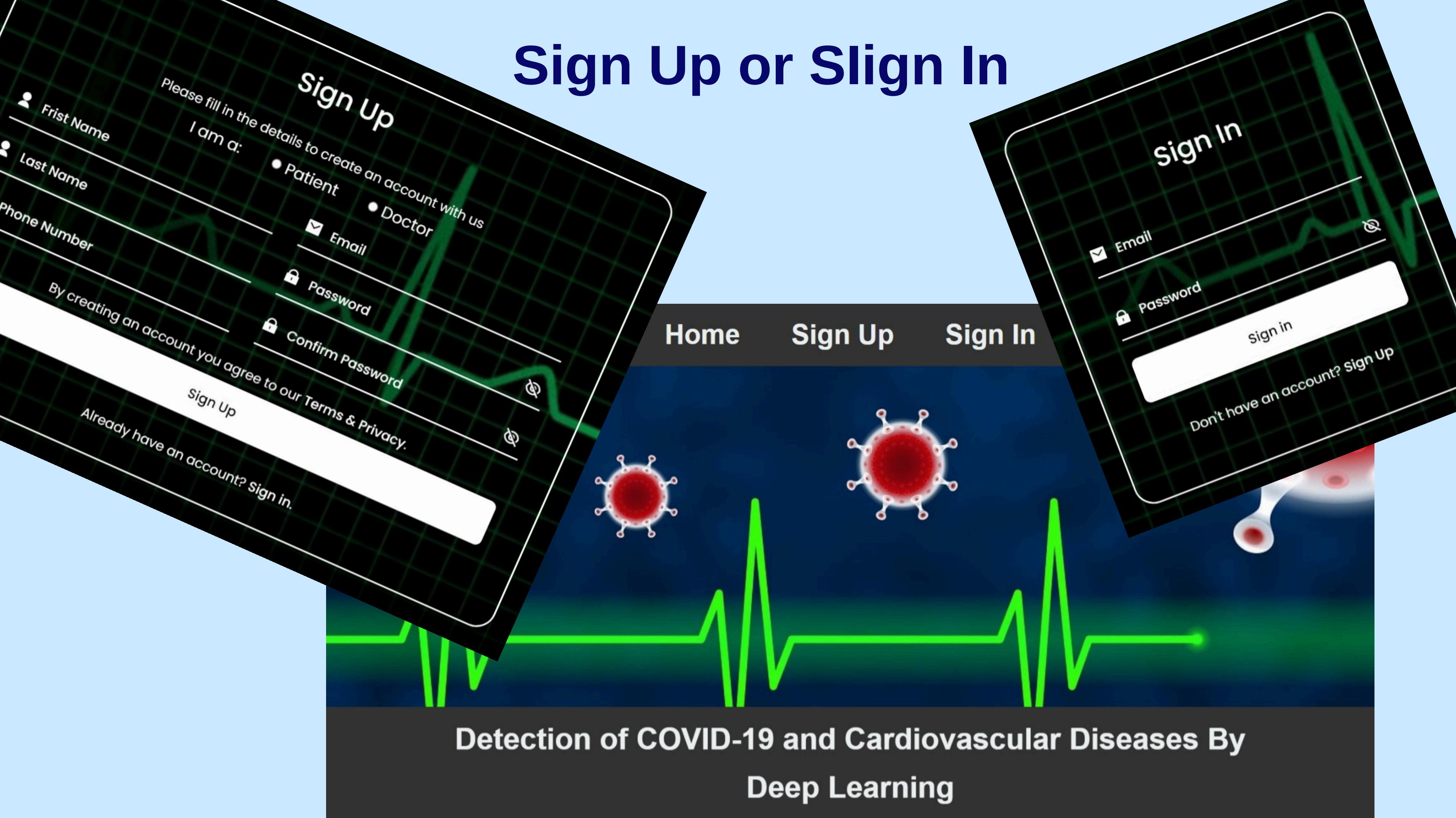
Accuracy of train : **0.975%**

Accuracy of test: **0.972%**

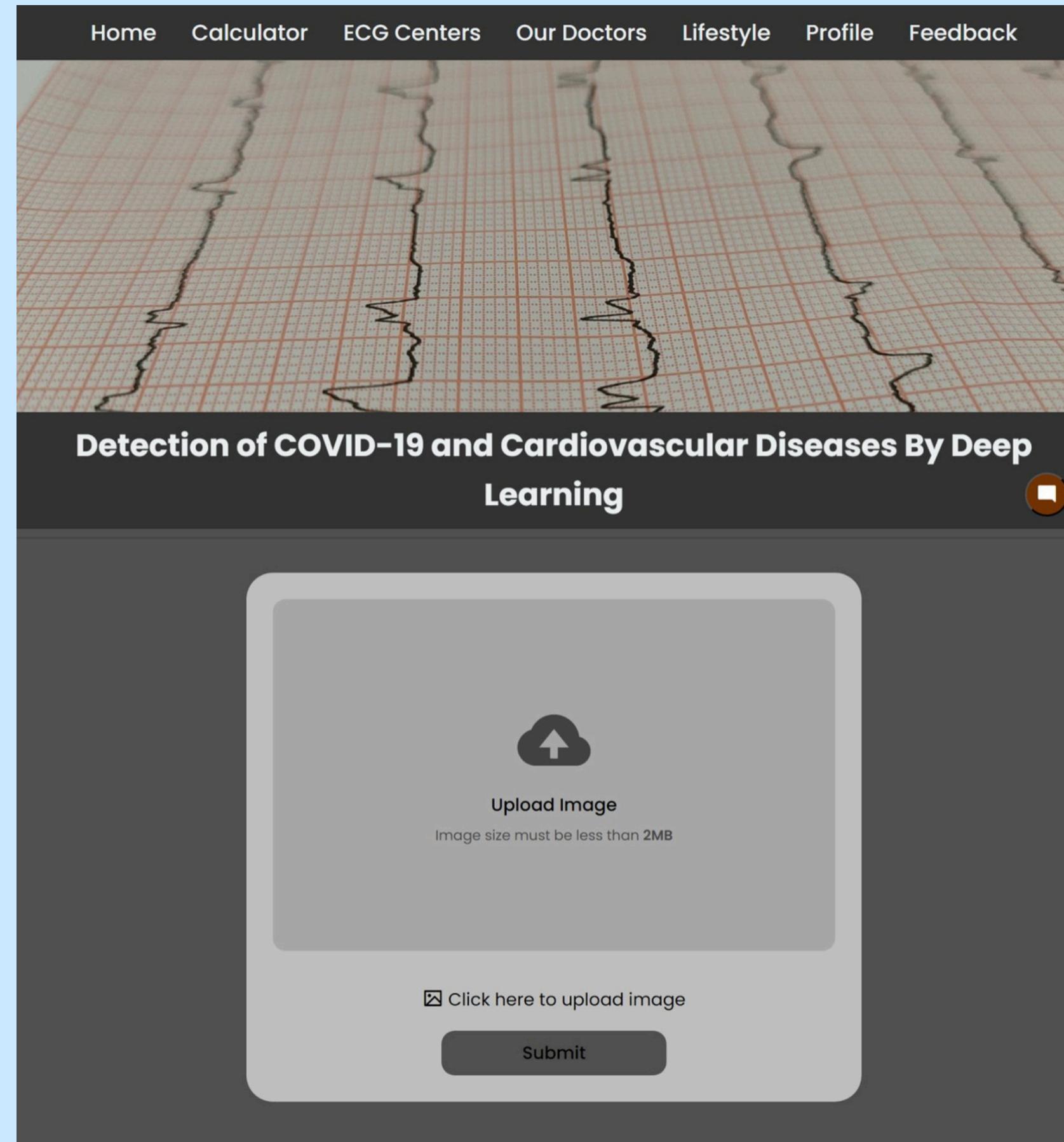
Loss of train:**0.06**

Loss of test:**0.09**

# Sign Up or Sign In



# Upload ECG-Image



# Chatbot for any Patient's Question

Home    Calculator    ECG Centers    Our Doctors    Chatbot

Hi there 🙌  
How can I help you today?

Detection of COVID-19 and Cardiovascular Disease

Learning

Enter a message...

X

# Risk Calculator

## HEART RISK CALCULATOR INFORMATION



Estimate Your Heart Risks from Heart Risk Calculator.

Based on the knowledge and experience we are gain from internet we implement an open source heart risk calculator, this health assessment can help you:

### HEART RISK CALCULATOR DEMOGRAPHICS



Learn your heart risk category, and what is normal  
Evaluate your risk for that heart attack, stroke disease and more  
Learn your Body Mass Index (BMI) number, and BMI category

GET STARTED

Age (years)

160

Systolic Blood Pressure

140

Physical activity (hours per week)

6

Weight (kg)

0

Are you a smoker?

History of heart disease?

Your Heart Risk: 5%

Your BMI: 24.22

Your BMI Category: Normal weight

Calculate Risk

# ECG-Image Centers

 [Alfa Labs](#)  
sohag Governorate

★★★★★

[Read More](#) [Location](#)

 [Cardio Scan](#)  
Al-Sharqia Governorate

★★★★★

[Read More](#) [Location](#)

 [Taiba Scan & Lab Center](#)  
BeniSuef Governorate

★★★★★

[Read More](#) [Location](#)

 [Cairo Scan](#)  
Giza Governorate

 [Dar Al Fouad Hospital](#)  
Cairo Governorate

 [Techno Scan](#)  
Dakahlia Governorate

Read More Location Read More Location

# Our Doctors



**Dr. Mohamed Fouad**

Expert Doctor



**Dr. Amr Imam**

Expert Doctor



**Dr. Mohammed Suleiman**

Expert Doctor



**Dr. Ahmed Helmy**

Expert Doctor



**Dr. Yasser Al-Nahhas**

Expert Doctor



**Dr. Amany-jamal-Al-Deen**

Expert Doctor



# Lifestyle Page

## contains recommended Healthy Food and Sports for Heart Patients and Covid-19 Patients

**Healthy Food**  
Some healthy recipes for heart disease and Covid19



**Whole Grains**  
Opt for whole grains like whole wheat, brown rice, oats, rye, and quinoa. These grains include all three nutrient-rich parts: germ, endosperm, and bran.



**Leafy Green Vegetables**  
Spinach, kale, and collard greens are rich in vitamins, minerals, and antioxidants. They contain vitamin K, which helps protect arteries and promote proper blood clotting.



**Fatty Fish and Fish Oil**  
Salmon, tuna, and trout are rich in omega-3 fatty acids, which have anti-inflammatory properties and support heart function.



**Green Tea**  
High in polyphenols and catechins, green tea has been linked to improved heart health.



**Avocados**  
These creamy fruits are a great source of monounsaturated fats and potassium. They can help regulate blood pressure and improve heart health.



**Walnuts**  
These nuts provide heart-protective benefits due to their omega-3 fatty acids, antioxidants, and fiber content.

**Sports**  
Sports play a vital role in promoting physical and mental well-being



**Swimming**  
Swimming is a remarkable activity that offers numerous benefits for both physical and mental well-being.



**Running**  
Improved sleep quality and duration increased weight loss and metabolism Lowered blood pressure and cholesterol levels



**Cycling**  
Cycling strengthens your quads, glutes, hamstrings, and calves without stressing your joints!.



**Yoga**  
Yoga enhances flexibility by incorporating various postures and stretches and may reduce inflammation and contribute to overall cardiovascular well-being



**Tennis**  
A study published in the British Journal of Sports Medicine found that people who play racquet sports, including tennis, have a marked reduction in all-cause mortality and a significant decrease in cardiovascular disease mortality.



**Golf**  
Golfers have been found to have improvements in risk factors for cardiovascular diseases, such as lipid and insulin-glucose levels, body composition, and physical inactivity.

# Patient Profile

## contains all data that the patient entered on the website

Name  
Enter your name

Age  
Enter your age

Email  
Enter your email

Password  
Enter your password

Phone Number  
Enter your phone number

Weight (kg)  
Enter your weight

Height (cm)  
Enter your height

Total Cholesterol (mg/dL)  
Enter total cholesterol

HDL Cholesterol (mg/dL)  
Enter HDL cholesterol

Systolic Blood Pressure (mmHg)  
Enter blood pressure

Physical activity (hours per week)  
Enter activity level

Alcohol Consumption (drinks per week)  
Enter alcohol consumption

Are you a smoker?  
Select

Do you have diabetes?  
Select

Family history of heart disease?  
Select

ECG Image  
Save

Doctor's diagnosis of your status:

# Comment and Evaluation of Patients for Website

## Patient Feedback

**Comment:** Lorem ipsum dolor sit amet, consectetur adipiscing elit.

**By:** John Doe ([john@example.com](mailto:john@example.com))

**Rating:** ★★★★☆

**Comment:** Nulla quis lorem ut libero malesuada feugiat.

**By:** Jane Doe ([jane@example.com](mailto:jane@example.com))

**Rating:** ★★★☆☆

Add your comment...

**Comment:**

**Rating:** ★★★★☆ ▾

Submit

# Doctor's Diagnosis per Patient depending on his/her Status

**Hello Doctor**

Please give your opinion and diagnosis of this patient's status after reading the patient's information.

Patient Status:

Doctor's Comments:

**Name**

**Age**

**Weight (kg)**

**Height (cm)**

**Total Cholesterol (mg/dL)**

**HDL Cholesterol (mg/dL)**

**Systolic Blood Pressure (mmHg)**

**Physical activity (hours per week)**

**Alcohol Consumption (drinks per week)**

**Are you a smoker?**

**Do you have diabetes?**

**Family history of heart disease?**

**ECG Image**

# Link model and make Api for website using flask

1

Create file “app.py” includes the deep learning model

2

When user upload image in “upload.html” page that opens a POST request to the URL "http://127.0.0.1:5000/predict".

3

the Api will get photo and go to server of flask to get result by XMLHttpRequest

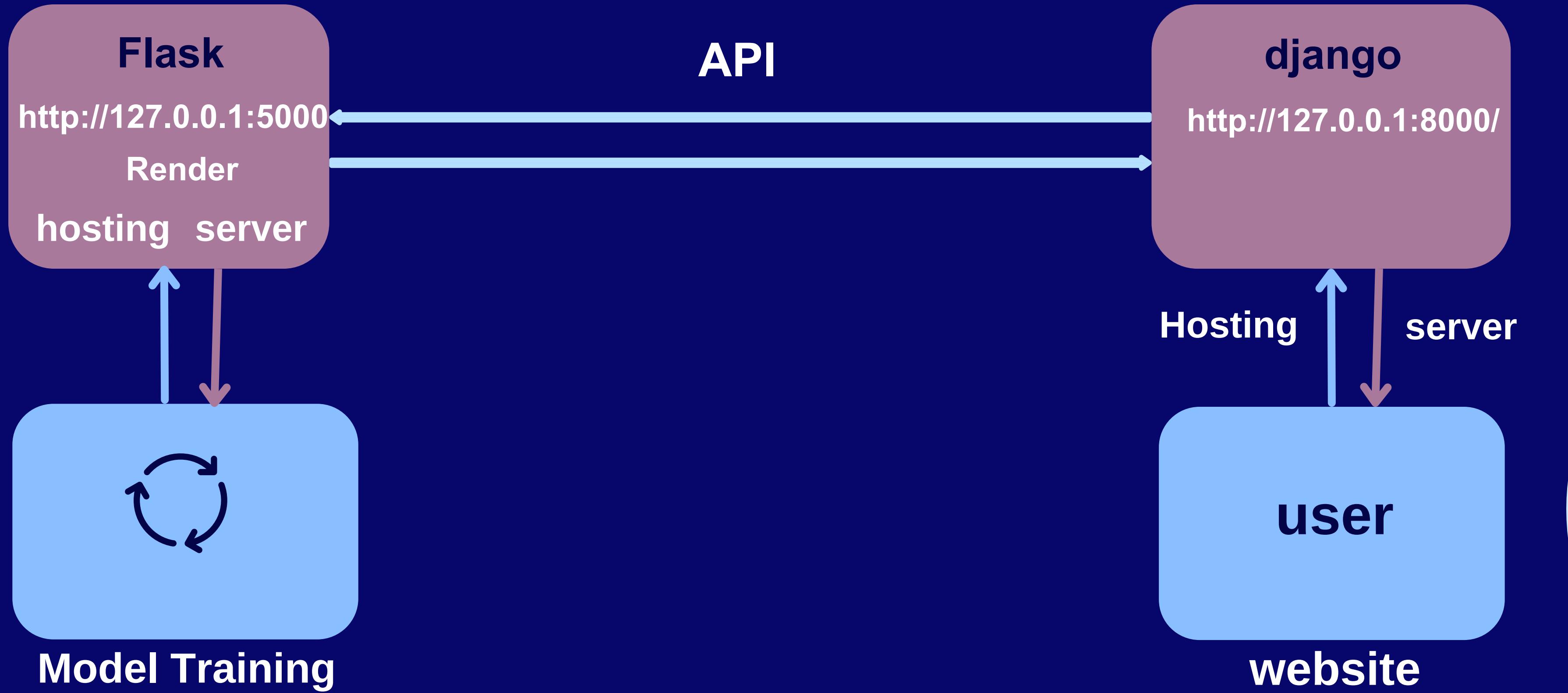
4

it retrieves the response text from the server When the request is complete to display the predicted category at same page.

5

The user can upload ecg image to check according to the division of types of ecg data

# ★ Architecture Overview

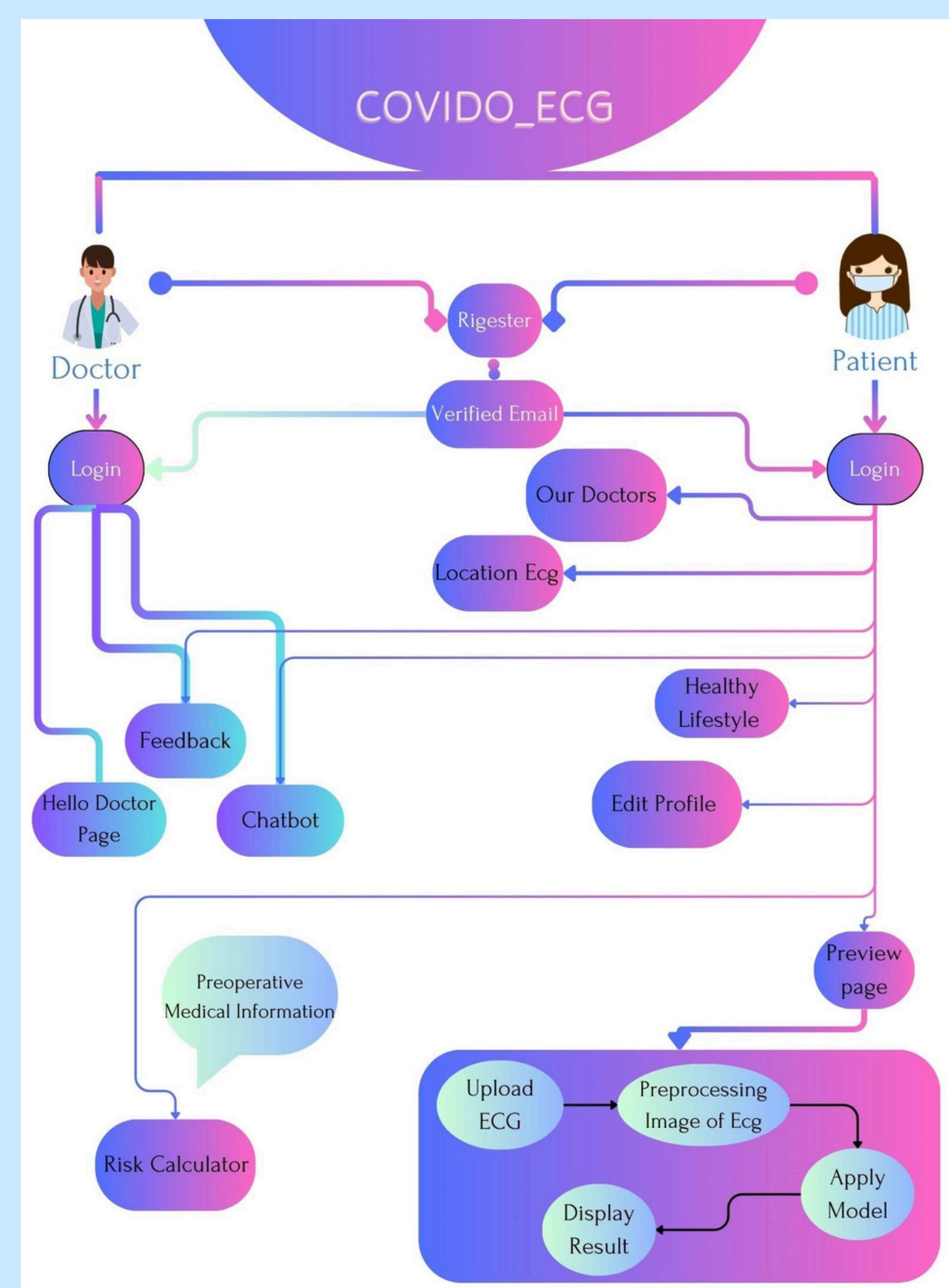


09

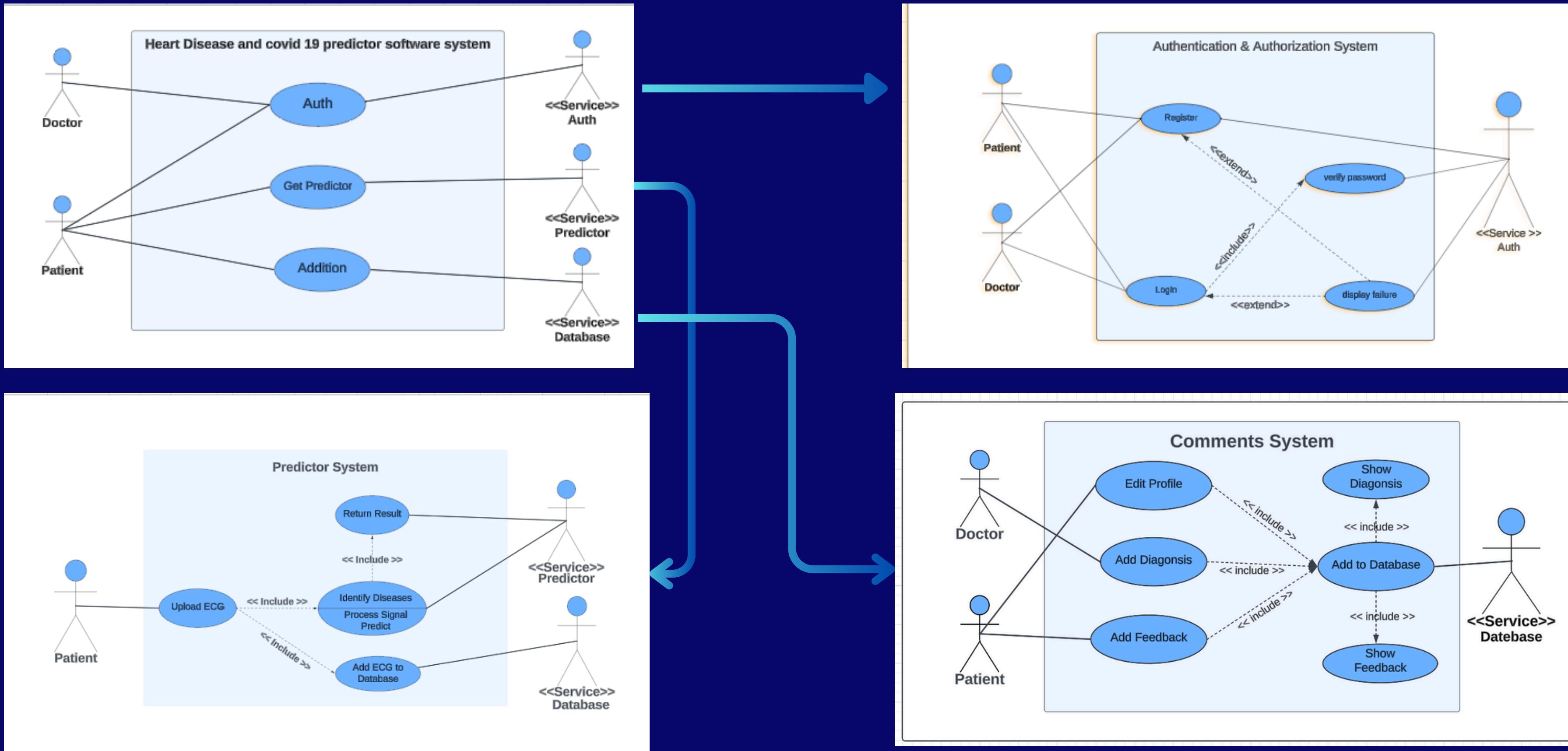
# Methodology



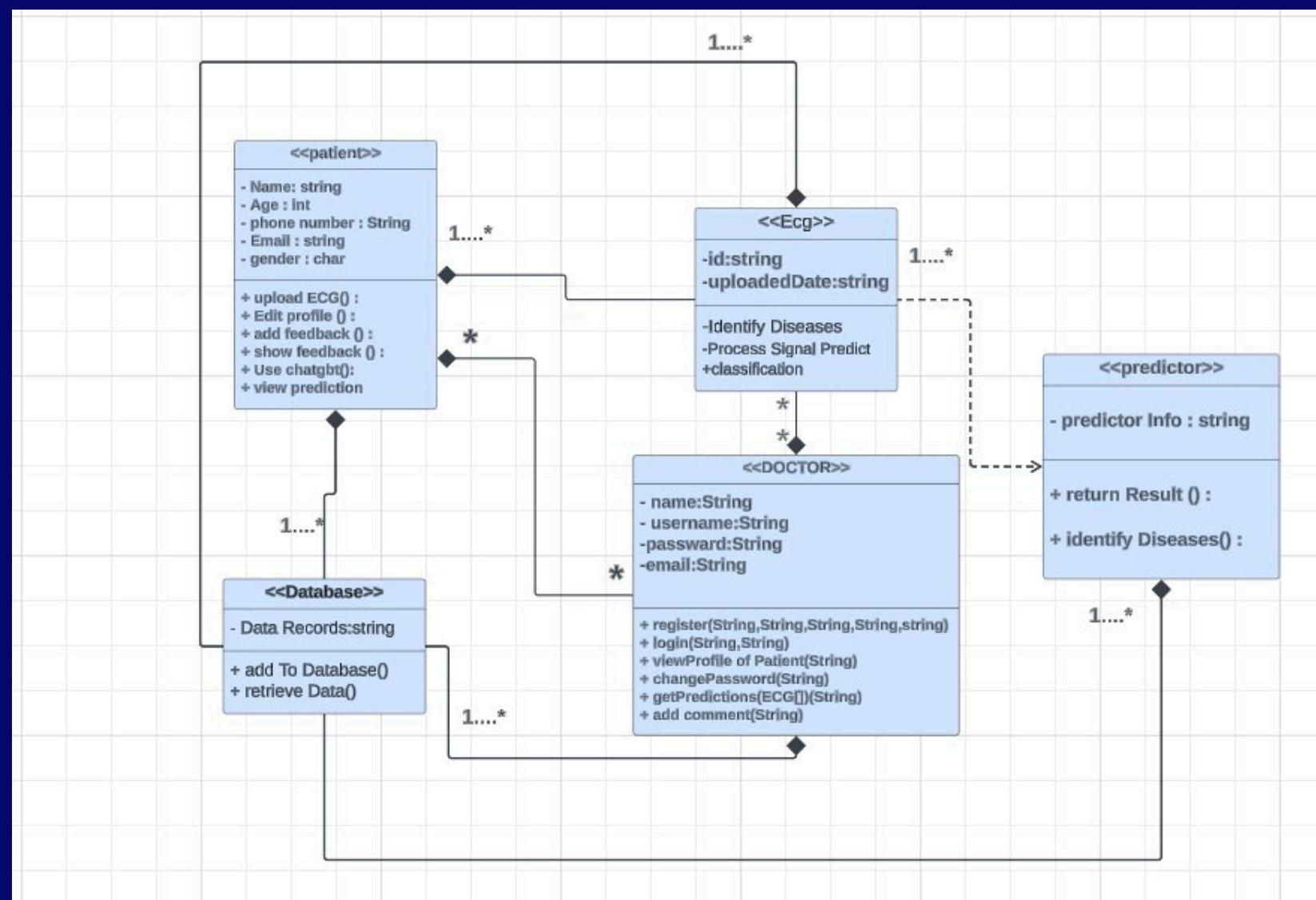
# Structure System



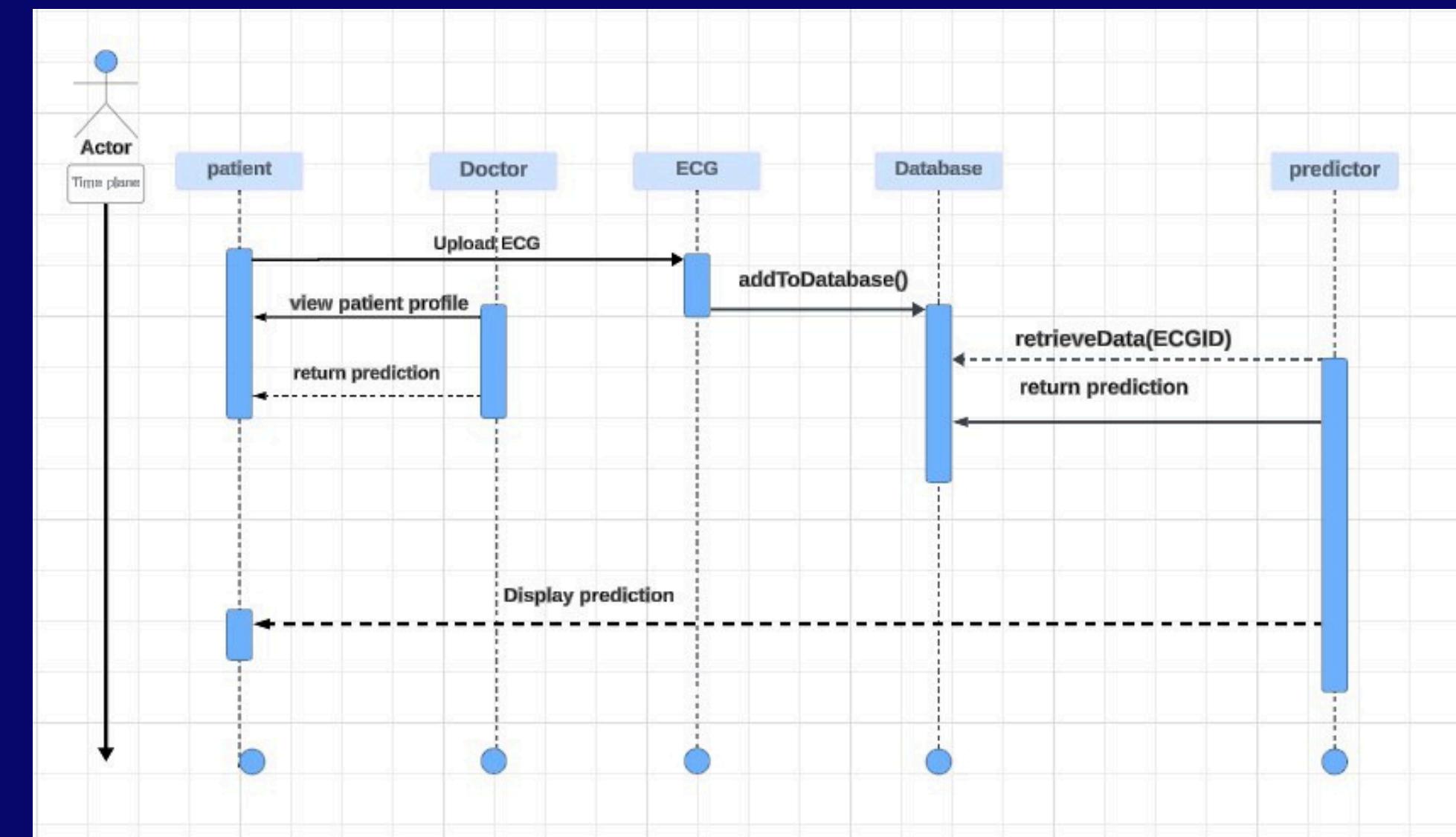
# Use Case Scenarios



# class diagram



# sequence diagram



10

# Technologies



## BACK END

**django**



 **python**™

AI



## FRONT



11

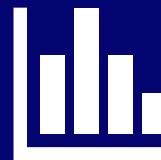
## TIME PLAN



# Time plan



Research and understand the idea of the project



Data visualization



- Implementation and build the model.
- Link model and make Api for website.



Obtain the final version of the project and to amend any proposals from the doctor and teacher assistant.



Understanding the dataset



- Preprocessing for data and augmentation
- Create a web site and **create database in MySQL**



- Improve accuracy
- add new features to website

THANK YOU  
VERY MUCH!

THANKS

